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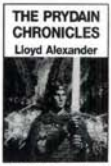

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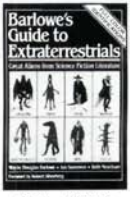

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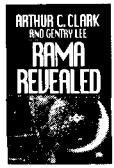

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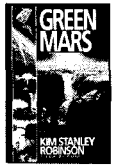

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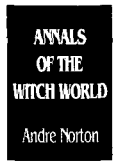

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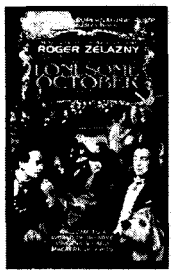

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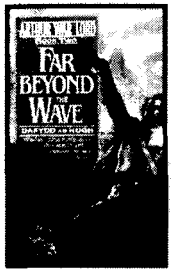

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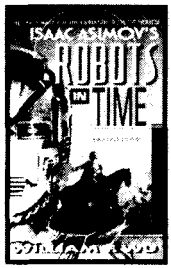

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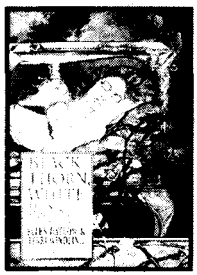

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EDITORIAL Stanley Schmidt

EVIL SPIRITS

A couple of years ago, an Associated Press article carried the headline, "Chefs launch battle against genetically altered food." Curious as to how genetically altered food was going to defend itself against militant chefs, as well as why the chefs were so militant in the first place, I read on.

The article repeatedly quoted a well-known chef who said he had never lobbied against anything before, but was, in the words of the article, "shocked when he learned that many genetically altered foods would soon be on the market." So he and some thousand other well-known chefs banded together to stamp out such evils as tomatoes that can be shipped fresh without spoiling. The valiant chefs took a public pledge not to serve genetically altered foods in their restaurants. "I owe it to my customers," allegedly said the oft-quoted chef, "to serve them safe, pure, nutritious food of the best quality."

That's surely a commendable requirement for a chef to impose on himself. But the implied assumption seems to be that genetically altered food is *not* safe, pure, nutritious food of the best quality. Nowhere in the article could I find any mention of *evidence* to support such an assumption. Nor could I find any qualifiers stating that the chefs might adopt genetically altered foods if they turned out to be *better* than their unaltered counterparts.

Yes, there was a mention of a campaign to require explicit labeling of genetically altered foods and testing to make sure they don't pose health risks. Up to a point, I can sympathize with these desires—though I do have doubts about how much time, effort, and money should be spent testing for risks whose existence nobody has any real reason to suspect. A full program of crash tests makes sense if you start making a car body out of a completely new material, but not if you just change the shape of the headlights.

What bothers me most in the article about the chefs is their apparent belief that New Is Bad and To Be Avoided, without any apparent attempt to determine rationally whether it's true, or any openness to

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the possibility that it might not be. The attitude seems to be that genetic engineering is a modern equivalent of Evil Spirits, to be avoided unthinkingly because this month's version of a priesthood says so.

Unfortunately, such an attitude is very common, and a flame that responds well to fanning. Somewhere near the same time that the chefs were uniting to do battle with defenseless tomatoes, an English professor at Boston College wrote a letter to the *New York Times* deriding genetically altered foods as "Frankenfood." The word caught on in quite a few places (though I must admit I haven't heard it much lately), and subsequent news coverage indicated that the letter writer was quite pleased with himself for coining the word and seeing it gain such wide usage. "I'm proud of this word," he was quoted as saying. "It has a phonetic rhythm, it's pithy, and you can use the 'Franken-' prefix on anything: 'Frankenfruit,' say. . . . "

Well, yes. Advertising types are always looking for words with those catchy qualities, and delighted when they find one. Whether their overall effect is beneficial is another question entirely. A catchy phrase expressing a bad idea can do a good deal of damage, because far more people will be taken in by its sound than will bother to analyze its meaning. One follow-up article on the "Frankenfood" phenomenon was a good example, its author apparently trying hard to match the original word's impact with such cutesie, emotionally loaded, but semantically empty phrases as "dangerous mutant innovation," "the monstrous unnaturalness of such new products as genetically enhanced tomatoes and chromosome-tinkered cows," and "the creepy world of bionic food."

I can easily imagine entire new technologies, of potentially great benefit to humanity, being rejected wholesale by the public, not because of any real dangers they pose, but because too many people make decisions on the basis of clever phrases coined by half-informed smart-alecks. "Frankenfood" carries connotations of mad scientists dabbling in Things Man Was Not Meant To Know and releasing their products into the environment to wreak havoc. In the same vein, might "Frankenfood" be a dangerous "Frankenword"?

I hesitate to say so, for the simple reason that I'm leery of any sugges-

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tion of suppressing *any* idea or opinion. The fact remains that some ideas *can* be dangerous, if they are wrong and widely accepted. The fundamental assumption underlying the belief that Free Speech Is Good is that bad ideas will be out-competed by better ones. But there's another assumption underlying that one, and it ain't necessarily so. Bad ideas will be out-competed by better ones if and only if people *critically examine* whatever ideas they're exposed to, conscientiously trying to reject the nonsense while preserving the true and valuable. That doesn't happen when people leap on every passing bandwagon without checking to make sure it has sturdy axles.

That is my point. My subject here is *not* genetically engineered food; it's the widespread tendency of people to embrace or condemn things without any data to support their decisions. I happened to choose genetically altered food as my opening example, but I could just as easily have used irradiated food or nuclear power plants. Both have attracted a large amount of quite similar public reaction, namely fear and attempts at suppression without bothering to learn enough to judge whether such actions are appropriate. My concern here is not whether any of these technologies deserves a great deal of trust, none at all, or something in between. My concern is that far too many people are making decisions about them with no rational basis—and decisions made that way are certainly *not* to be trusted.

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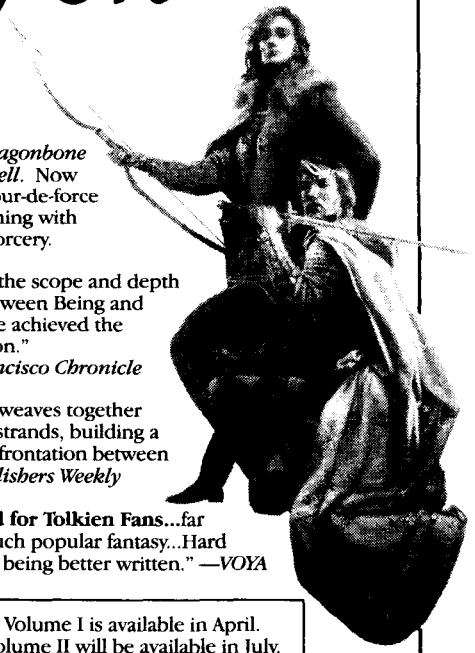

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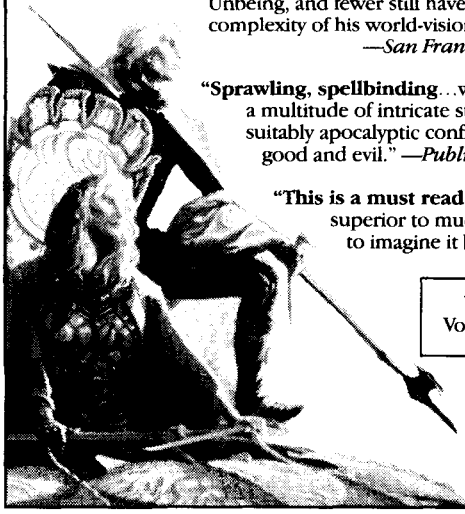

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Nuclear plants can have problems, of course, some of which can even create variable (but always finite) amounts of danger. Examining those risks closely and critically to determine whether they're acceptable is certainly a rational thing to do, and the decision may go either way. But few of the loudest opponents of nuclear power have anything like a quantitative (much less accurate) conception of the nature and magnitude of the risks. They have little or no idea of which kinds of problems are even possible for a particular installation. They point to Chernobyl as a Bad Example, but have no awareness of the design differences between Chernobyl and reactors closer to home. People persist in equating power reactors and bombs, blissfully ignorant of the features that make a nuclear-bomb-type explosion impossible in most of the former.

Food irradiation, already long used in some other countries but only recently approved for certain categories of food in the U.S., uses measured doses of relatively low-energy ionizing radiation (e.g., beta and gamma rays from Co^{60} or Cs^{137}, or X-rays of 5 MeV or less) to kill bacteria in food. This has at least two beneficial effects: reducing direct danger to the consumer from foodborne pathogens such as *Salmonella*, and retarding spoilage in at least some foods. The food never comes in contact with radioactive material, and nothing in it is made radioactive (the radiations used are too low-energy to transmute the ingredients). The FDA, the USDA's Food Safety and Inspection Service, and numerous other research organizations have done extensive research on the safety of the technique, even looking at such small and remote dangers as the indirect production of toxins by chemical reactions following ionization. The studies offer lots of evidence that food irradiation has many large benefits and few, if any, dangers.

Yet a sizable segment of the American public, egged on by well-meaning but ill-informed "consumer advocacy" groups, remains strongly resistant to the idea of eating irradiated food. Why? Because it involves Radiation, and Radiation is an Evil Spirit. It would take very little effort for anyone to learn in a basic way what's really involved; yet we seem to be stuck with the unthinking (and wrong) assumption that irradiation makes food radioactive and dangerous. If somebody learns how it's done and what its effects are, and then decides that for some reason that makes him want to avoid it, that's his privilege. But making the decision *without* learning any of that is stupid —and common.

A while back I got a letter from a reader suggesting that this kind of reasoning—or lack thereof—is a result of the public's exposure to science fiction. I can see his point, in a roundabout way, *if* you consider the term "science fiction" applicable to many of the horror flicks that come out of Hollywood and elsewhere. Personally, I don't, though I realize that much of the public has little or no conception of the difference. It seems to me that real science fic-

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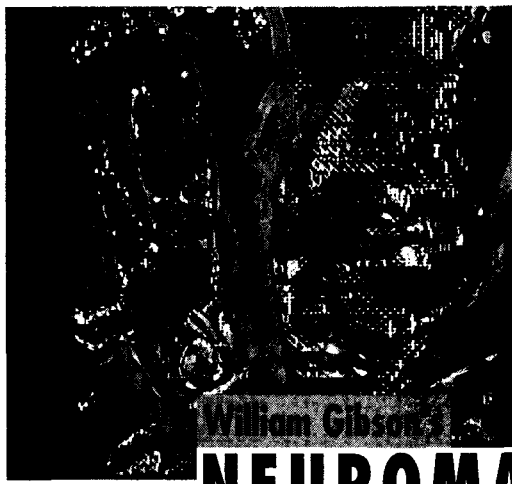
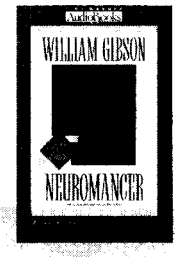
"The sky above the port was the color of television, tuned to a dead channel."





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tion—the kind *Analog* has always tried to present—should have the opposite effect. It should make people realize that things are constantly changing, that most changes involve potential risks as well as benefits—and that the proper way to weigh risks against benefits is through *reason,* not mere emotion.

But it seems that that idea, as far as the general public is concerned, is one whose time has not yet come. ■

IN TIMES TO COME

Our October cover again comes from Spider and Jeanne Robinson's four-part serial *Starmind,* part three of which appears in next month's issue. It's a bit unusual for a serial to get two covers, but occasionally a novel will contain a scene so visual that the temptation is irresistible!

We'll also have two quite different novelettes. Grey Rollins's "The Missing Link" continues his epic of the evolution of a lunar colony as opened up (no puns intended, of course) by the Holmes Door, a Really Easy Way to get from here to there. Rob Chilson and William F. Wu's tale takes a familiar phenomenon of our age a big step further—but not necessarily in the direction you'd expect.

We'll also have short stories by Jayge Carr and F. Alexander Brejcha, and a science fact article by Duncan Lunan with a title that is meant to be taken quite literally: "Keep Watching the Skies!" A couple of months ago we were pondering the imminent impact of a comet on Jupiter; what are the chances it could happen *here?* And what could we do about such a threat?

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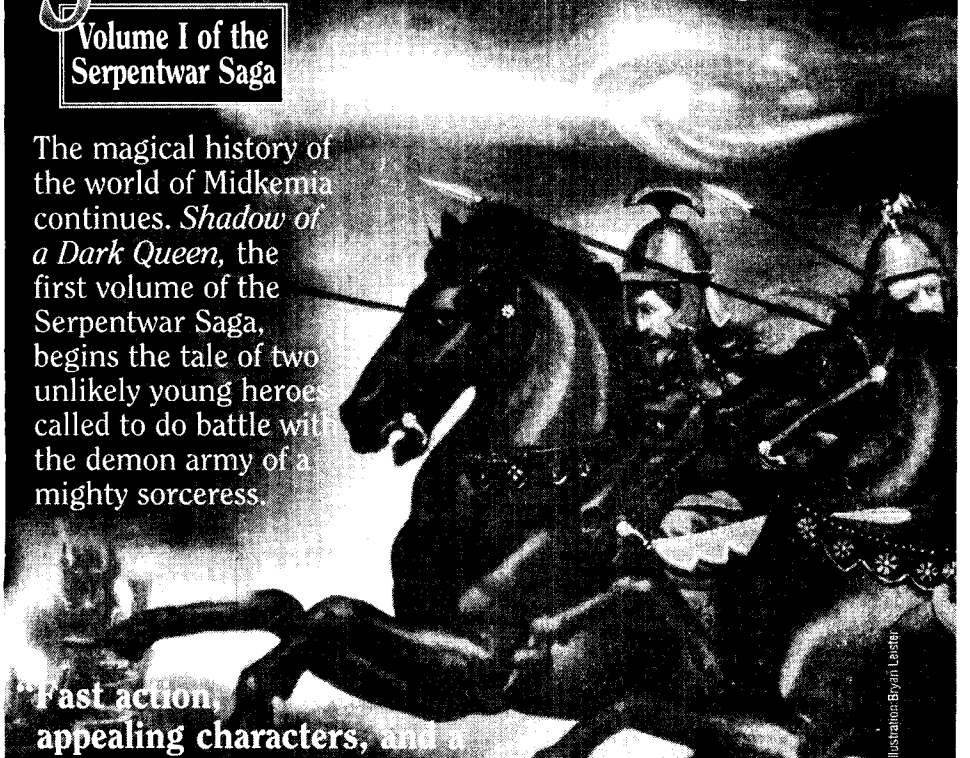

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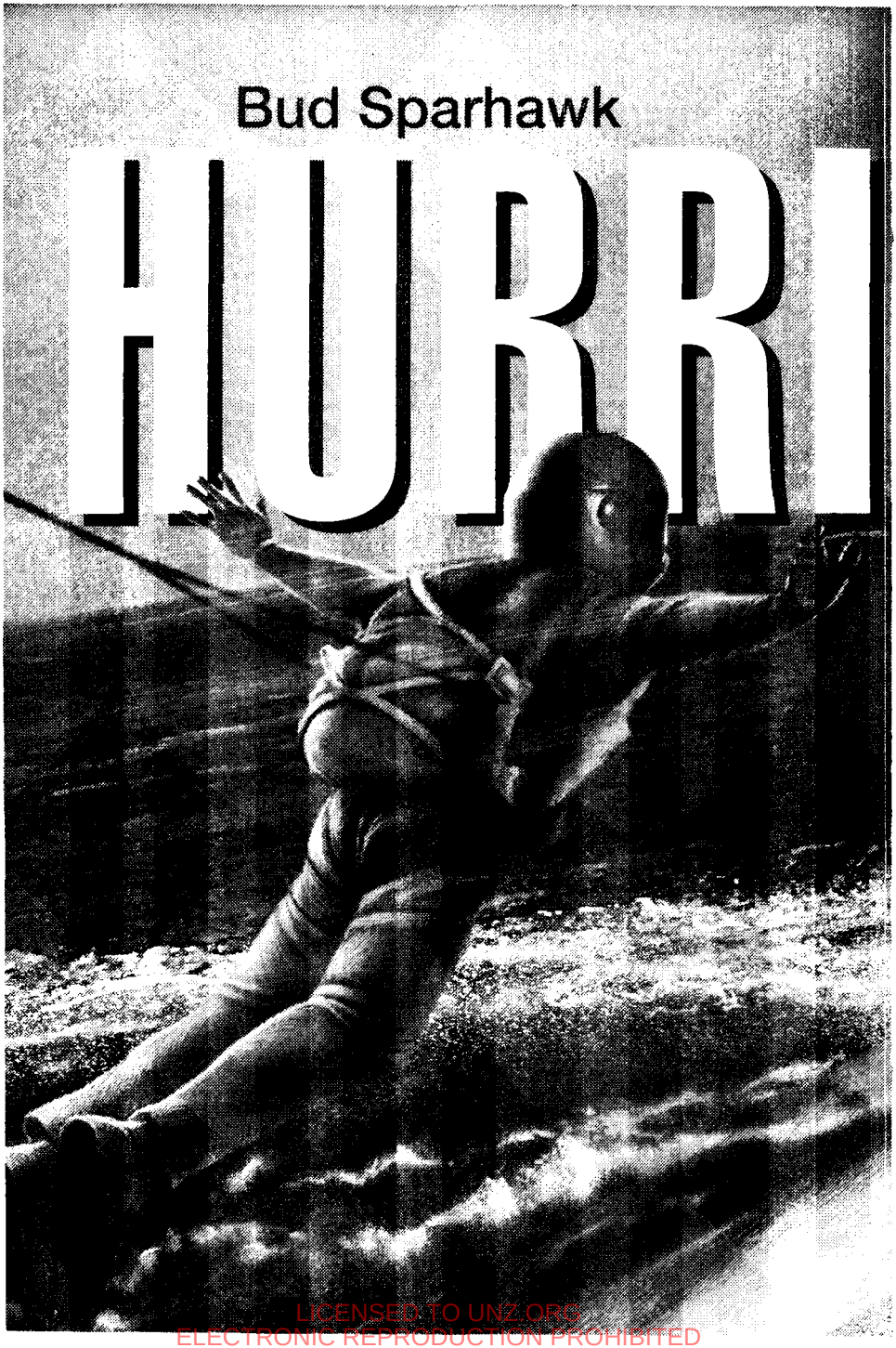

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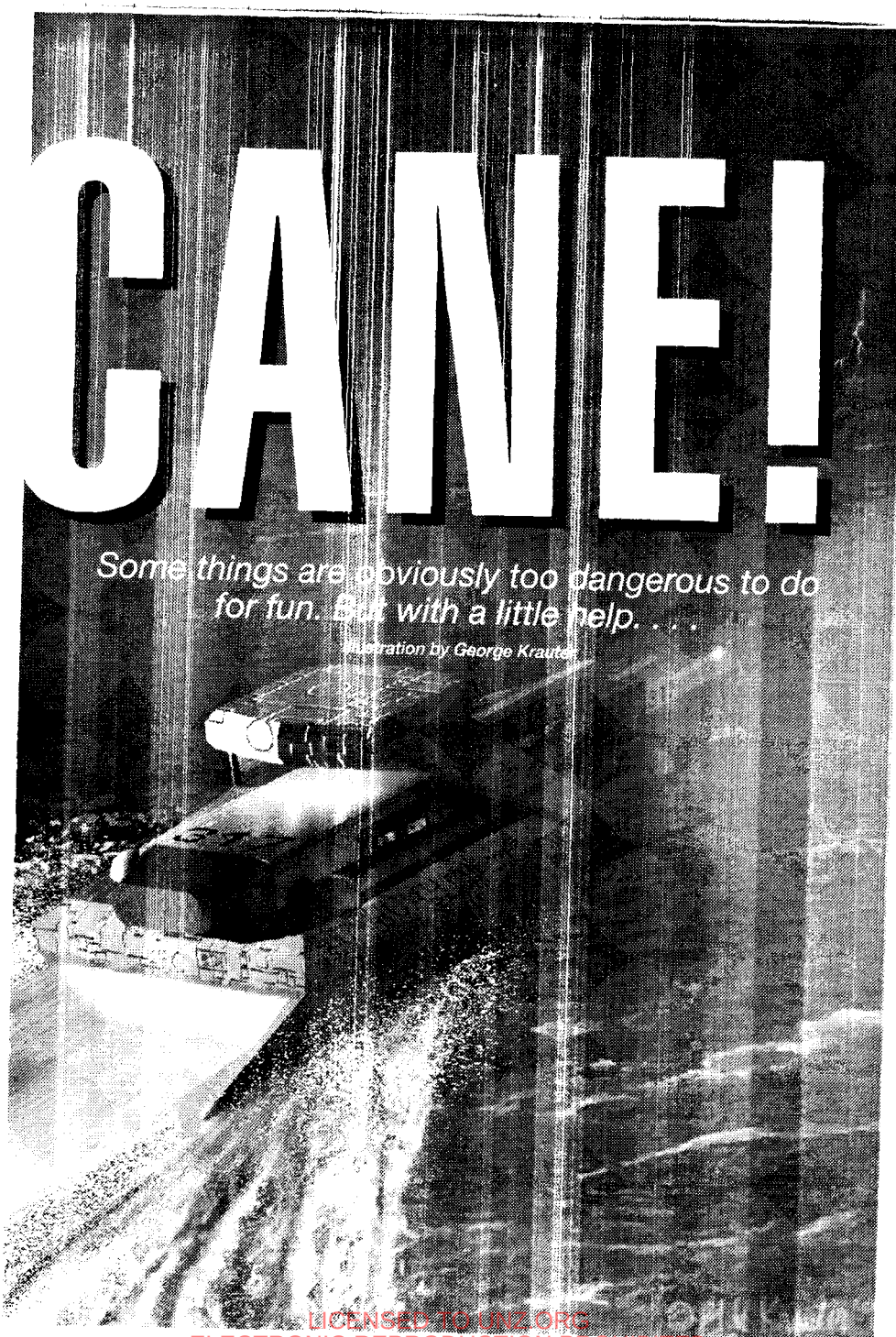
CANE!

Some things are obviously too dangerous to do . . . for fun. But with a little help. . . .

Illustration by George Krause



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The late September weather was crisp and clear outside my downtown office as a flurry of homeward bound office workers scurried for the Metro across Connecticut Avenue, eight floors below. Off in the distance I could hear the ever-present whine of sirens, normal background noise in Washington, just as the cloud-specked sky above was a seldom noticed constant in this city where the focus usually was on more mundane and immediate things.

The telephone rang just as I was pulling the file on the Severance drums and fries matter out of the cabinet. "Janice has turned north," Jerry Nord's voice on the other end said abruptly. "She'll hit the gulf stream sometime in the next twenty-four hours."

"What's her status?" I asked, my heart starting to accelerate from the rush of adrenaline as the impact of his words hit me. "Has she been upgraded from a tropical depression again?" The three previous candidates had proven less to our liking, one turning toward the Georgia coast, the second dropping back to a tropical storm just as we were ready to launch, and the third swinging over Florida, with much attendant destruction. I wanted to be sure that this one wasn't going to be a waste of time and effort as well. Janice had already changed status once as she shifted north.

"Better," Jerry fired back. "Her surface winds are over thirty-three meters per second; she's a bona fide hurricane and still growing." He paused and then Mariah's voice came on the line in a rush; "Why are you wasting time talking on the phone?" she shouted. "Get your ass out of that chair and get down here right away. We don't have a lot of time to get the boat into position!"

"On my way," I replied eagerly to both of them. As soon as the line went dead I told my administrative assistant to rearrange my schedule for the next week and get me a seat on the next plane to Charleston. Then I told Tonya to inform Severance that we'd deal with her demon when I got back, and quickly shoved her papers back into their folder.

That done, I hit the autodial for my apartment and counted the rings; four and it would roll over to the answering machine, meaning that Billie was out. Just as my hackneyed message was about to start she picked up the phone. "Janice is the big one again," I said before she had a chance to say anything other than "Hello" in that little girl voice of hers. "Throw some of my clothes in my travel bag and put my bathroom stuff in my dopp kit for me. I'll be by in half an hour to pick it up on my way to the airport." I slammed the phone down, grabbed my coat, and headed for the elevator before I remembered that I didn't add the obligatory "Love ya," before hanging up.

"Billie," I yelled as I unlocked the doors to the apartment when I got home. I was hoping to give her a quick hug and kiss for luck before I left, but there was no answer. I found my bag sitting in the hall with a note pinned on the top. I shoved the note

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into my pocket, grabbed the bag, and rushed out the door, hoping that my garlicky, swarthy cabbie had understood enough English to grasp my promise of a generous tip if he waited.

I remembered the note as the cab jostled with the other cars to ease into the flow of evening traffic across the Fourteenth Street bridge toward National airport, and fished it out of my pocket. *"I can't believe that you are doing something so idiotic and stupid,"* the note began lovingly in her elegant handwriting. *"Despite everything that I say you still seem determined to kill yourself in some spectacular manner. You've got to be insane to try a stunt like this and I don't want to live with someone who has a death wish. I will be gone when, and if, you return. Don't bother to call."*

A cold knot formed in my stomach. Where would I be without Billie? Should I turn back and try to stop her? Or was this just another of her dramatic ploys to get me to do what she wanted? I leaned forward to tell the driver to turn around when I caught the tail end of the weather forecast from his radio; "... Could prove to be the storm of the century," the announcer said. I settled back in my seat, shoving the note into my side pocket: Providence had intervened, reminding me of Janice's siren cry. The weather report was her way of beckoning me, I was sure. Maybe I could still make up to Billie when I got back, but my Janice was an ephemeral mistress, never to be courted again once she had passed my way. *She* would give me no second chance.

The flight to Charleston was uneventful. I drank two cans of apple juice and didn't eat the peanuts they offered since I was still on the low residue diet Jerry and Mariah had recommended we follow at the beginning of hurricane season. The 767 had a few moments of rocking turbulence over Charlotte as the plane encountered the bumpy air on the leading edge of Janice's distant center. "I am coming. I am near," her nudges seemed to say to me. Almost three years of preparation for this day lay behind me, three years of trying to plan every aspect of our conquest of the biggest storm of all—a full-fledged south Atlantic hurricane!

The whole thing had started while Jerry and I were taking a three-day trip on the upper Shenandoah River in the early months of summer a few years back. That time of the year was the quiet period for storm jumpers. The spring storms were gone and it was too early for the squall lines or the hurricanes to start. The Sun had to pump a lot of heat into the atmosphere to get those weather cells going so we had some time to just relax.

The upper part of the Shenandoah is a nice technical challenge; a maze of rocks and boulders interlaced with streams of inches-deep water. We had to fight our way downstream, often having to backtrack when we chose the wrong route and had to try another. Stubborn pride always kept our portage to a minimum, even if it was only a few steps, with the result

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that we worked twice as hard as necessary to make a few miles of river. Occasionally we would find an arm that stuck off and would explore it to find what it might reveal, often ending in a marshy mess of cow flop and mud. Too seldom we found a decent rapid—more of a challenge in a canoe than our usual kayaks, which could not carry the camping gear.

We talked about a lot of things over the campfire that night. Jerry had been doing some thinking about the big storms and needed to talk it out. "We've been jumping storms for a few years now, you and I," he began. "Damn near mastered most of the them, too." Jerry, modest soul that he was, didn't mention that he was not only the top storm jumper in the world but also the premier maker of storm jump equipment: His line wasn't the biggest nor the widest; it simply consisted of the best quality jump gear in the world. You never had to worry about the reliability of one of Jerry's parachutes, they were over-engineered far beyond the expected range of conditions. Neither could you fault his lovingly assembled, handmade electronics; altimeters, wind gauges, computers, radios—everything storm jumpers needed to preserve their stupid hides once they headed into the mouth of the beast. Naturally Jerry guaranteed every one of his products with his own life, using a random item from his inventory for his own jumps. It not only ensured adequate quality control but was a hell of an advertisement as well.

Jerry stirred the fire with a stick and continued; "Sometime every August or September the big depressions blossom in the southern Atlantic and move along the east coast. I was wondering if we could jump one of them?"

"Holy shit, Jerry," I exclaimed in shock. "You're talking about jumping into a damned hurricane, aren't you! Are you crazy or something?" I mean, we all talked about it, mostly braggadocio and wishful thinking. After all, a hurricane was just a big storm, right? Yeah, and a tyrannosaurus was just a big gecko. As far as I know Jerry was the only certifiable expert who had even voiced the possibility of actually trying it.

"Klien did it," he said quietly. "Jay jumped and managed to survive." As if that was any excuse. Klien had jumped against all advice when hurricane Fred had crossed the Florida coast. He had ended up with multiple fractures, a collapsed lung, and the ridicule of nearly everyone who followed storm jumping. When they finally fished him out of the Gulf all he was concerned about was if his stupid camera was still intact. His computer indicated that he'd gotten just a thousand meters into the storm before Fred ripped most of his jump gear away, smashed him around for long agonizing minutes, and finally plunged him into the surf where he was beaten by flotsam and jetsam for half the night. Jay had been an idiot for making the attempt, everybody knew that, and foolishly lucky to have survived.

Only, I wondered, why was the idea so deliciously appealing when

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coming from Jerry? Probably because the idea of mastering the might of a full-fledged hurricane would be the pinnacle of storm jumping: the equivalent of climbing Mount Everest for the first time. And Jerry would be the best sherpa guide anyone could hope for.

He tossed a twig into the fire and watched the flame flare into brief life. "I think we can work out most of the techniques for doing it safely. It's just a matter of planning things out in detail and having the right equipment. Well, you sleep on it and let me know if you want in on it."

"You really are going to do this, aren't you?" I asked when the embers were just a cherry glow and the last of the tea was gone.

"Yes," he replied. "And you're going to go with me," he replied, turned over in his sleeping bag and went to sleep.

"No, I won't," I said testily to his back. "You are one insane bastard. I won't be a party to your suicide." There, I thought, that should end the discussion.

Jerry never referred to his crazy idea the rest of the trip, although it was never very far from my mind. The excitement of jumping into a major hurricane drew me on the one hand, while the danger that it posed to my life and limb pushed me away. The idea thrashed back and forth within my thoughts for days after. Not that I had any real control over the situation. Jerry knew I would come around to his way of thinking, no matter what I said.

Finally I could stand his silence no longer. I called him up to tell him that in no way was I going to go along with his crazy idea. . . . I ended up flying to Florida to try out some of his ideas in one of the "small" tropical squalls. One jump with Jerry's proposed equipment and I was hooked. Nothing was going to keep me away when Jerry made his assault on the big one.

Over the next year Jerry and I painstakingly worked out the ways we could harness a hurricane's power to our advantage. In a seemingly endless succession of jumps into nightmarishly bad weathers we discovered what worked and what didn't. The failures were the really scary parts for both of us, especially the ones that we almost didn't survive. By the time we had completed our research we had earned a reputation in the jump community for being reckless, crazy, and stupid; which is quite an honorific in that brotherhood.

A big change in our plans came when another spring came around and we decided to do the Youghiogheny River. Every decent white water enthusiast on the east coast loves the Youghiogheny River, the lower Youg, that is, from the easy stairstep riffles at the top, just below Ohiopyle Falls, to the roaring Class V and VI rapids down toward the bottom. We planned to start our run at the Loop takeout, right at the top of the thirteen-kilometer drop down to Brunner Run. Once you get under the bridge below the Loop you have to keep going because the river drops five meters per kilometer, about sixty

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for the whole run, which builds up a hell of a roaring sheet of water to ride.

Another kayak had just put in when we got to the edge of the stream and was paddling upstream to get into a decent position for a solo run. I waved my arm to signal we should all make the run together, wondering if the other guy would be able to keep up with us as the difficulty level increased down below. The fact that he had put in at the Loop told us that he wasn't a raw beginner, the kind whose courage would fade when he hit anything above a Class III rapid. He waved back with his paddle, backed until we were in the water and then took off like a shot right through the gap and under the bridge, making a nice tight stem turn with the main flow.

He was riding the hydraulic at Dimple Rock when I shot the chute, letting me lead Jerry and him through Swimmer's hole and down the Cucumber, a rapidly accelerating stairstep of rough waters that starts as Class III and ends with a Class IV bone-shaker. By the time we reached the Bottle I had gotten a measure of our companion; reckless, daring, and a little crazy. In other words, a normal white water enthusiast. Jerry went through the Bottle of Wine in his normally cautious fashion, not sacrificing speed for safety, but not taking chances either. Then Jerry and I waited upended in the smooth hydraulic below the Bottle when the other guy came through hell-bent for leather, zipping by us in an effort to be the first to hit River's End.

The End isn't my favorite piece of the river. Right at the top of the passage through the mass of rocks there's a double hydraulic that gives a great ride, but only if you keep your speed up. Slow down and the second backwash will drag you in and down, giving you a double dose of the wet lung disease as it yanks you out into the current. Once you are past that hazard, and hurtling along at a good clip, you enter the Canyon. The huge boulders rearing up on either side always give me a claustrophobic feeling while I'm twisting and turning to stay in the channel. Drifting just a hair to either side of the Canyon means that the current will smack you against one of the huge rocks. If that happens, and you don't twist in time, the water pressure can pin you there, holding your kayak flat against the rock face with tons and tons of water pouring over you. As if that wasn't dangerous enough, the bottom of the End opens up on a cascading series of haystack hydraulics, upwellings that can throw you into next Wednesday if you aren't careful. I usually try to go around them and stay close to Whale Rock where there's a slight eddy current. Jerry takes an even more deliberate course over the first one and around the next two.

When I finally worked my way to the bottom and made the swing at the rocks I had the shock of my life. Our erstwhile companion was riding upright on the last of the hydraulics, calm as you please. "Race you guys to the take out," he yelled in a feminine voice. The high-pitched voice told me that the guy was just a damned reckless kid!

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There was no way I was going to let some hot dog kid beat me on my river! I turned the kayak with a vicious sweep of my paddle, did a rollover to refresh myself, and waited for the kid to come abreast. When he shot by me, using the impetus of the water gushing out of the End to give him an extra boost I realized my mistake: I had to build up speed from nearly a dead stall while he was gaining speed with every sweep of his paddle. The kid was really good! Jerry was two strokes and three lengths ahead of me in pursuit by the time I got my ass in gear.

By the time we reached Schoolhouse the kid was tens of meters ahead of me and skipped though the washboard without missing a beat. Jerry gained a little on the flat water to Laurel Run and lost some when the kid took the dangerous, but faster route down the Stairstep; something only daredevils or damn fools usually attempt. The three of us hit the Brunner Run rapid side by side and dueled down the riffles, Jerry leaning to caution, me finding a middle course, and our opponent taking chances with every hazard. I managed to cut across at the bottom of the riffles, where the water flattens out, and squeezed him off on the big rock to the right, forcing him to either hit the rock or follow. I swept around in a victory curl right at the takeout, just a few feet ahead of Jerry. No kid was going to show us up!

Which is why both of us manly men were stunned when the kid beached the kayak, stepped out, took off the helmet, and shook out that head of flaming red hair that beautifully set off Mariah's dark green eyes. I think Jerry fell in love the instant she flashed him that smile of hers.

Mariah and Jerry began to see a lot of each other in the next few months after our meeting on the lower Youg. He told me that she was an accomplished hang glider, sailplane pilot, and sport parachute enthusiast. From his tone I knew he was hooked, big time. Well, it was just a short step for Jerry to get Mariah to try jumping a few storms. Before long she was better at navigating the erratic winds than anyone else on our team. She was a natural and, frighteningly fast, acquired an expert's skill. Trouble was, she got so damn good that hubris reared its ugly head: She felt she could do no wrong and wanted to start pushing the envelope.

There was a hell of a row between the two of them over where to draw the line between risk and foolhardiness. Mariah's style was the opposite of Jerry's. She was the daredevil of the pair, willing to risk everything on the chance, providing the payoff was worth it. Specifically, she wanted to try jumping the squall fronts that moved like freight trains across the Oklahoma plains. Everyone, even the craziest storm jumpers, thought the idea was too dangerous to even think about it. Jerry carefully explained to her that those type of storms were too poorly organized and unpredictable to jump safely. It did no good, but he did try to talk her out of it.

The result of all the talks and discussions and warnings was that Mariah did some squall line jumping on

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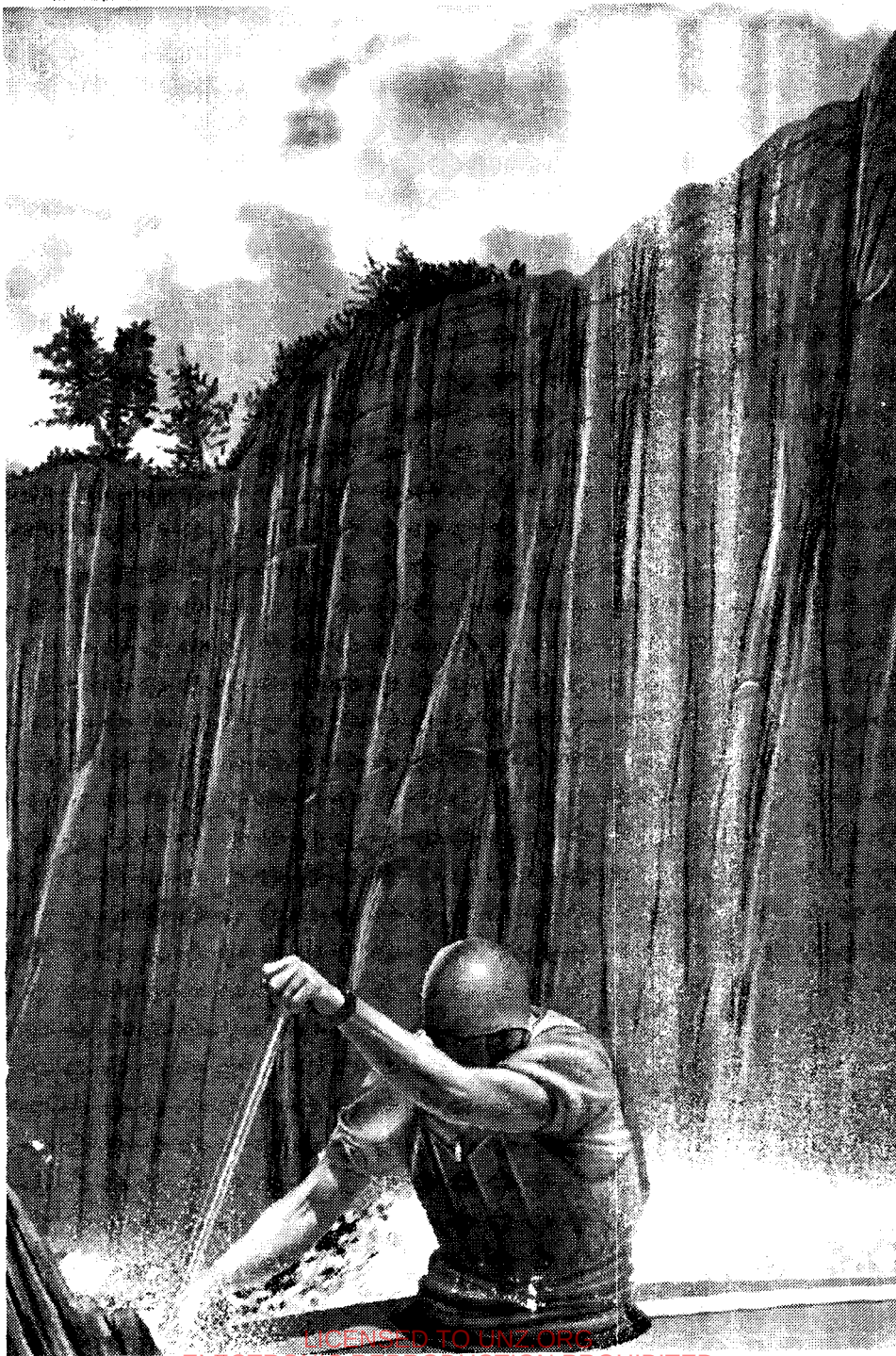

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her own, including one autumn jump with some experimental gear that Jerry had devised for our hurricane assault. To prove that everyone else was wrong she had ridden a roaring monster of a tornado for nearly twelve kilometers across Oklahoma, clocking ground speeds of nearly three hundred, and lived to tell about it. That storm blew her clear across the state before depositing her in the only tree within ten kilometers of her landing site. So what if she broke both legs, not to mention a dozen or more other minor and major bones in the attempt—she had proven that she could do what the veterans said couldn't be done!

Jerry proposed to her in the hospital while she was lying there, defenseless in her casts and semi-comatose from the sedatives. He figured that someone who could ride a tornado and survive was worth holding onto. Can't say I blamed him. I was best man at their wedding—which occurred between fifteen hundred and a thousand meters, surrounded by the rest of the jump club, and a very, very scared-looking minister. After that it was taken for granted that Mariah would be going with us when we tackled the big one.

The change in the pitch of the engines, the chiming of the tone, and the announcement from the stew to put our seatbelts on brought me back to the present. The plane abruptly began its descent. On the way down the crosswinds made the plane lean sickeningly to one side, slip, and then come back level. A kid in the back started to cry. The wind managed to smash us around a few more times before our wheels banged three times onto the rain-slick runway and started rolling down the seemingly endless taxi run to the Charleston terminal.

The wind-driven force of the rain beat a steady drum roll on the roof of the rental car as I recovered my luggage and drove to pick up Jerry and Mariah and drive to the harbor. To all those around me the rain, wind, and thunder may have just been aspects of another summer storm, but I knew better; even from a thousand miles away my Janice was already calling me into her arms.

Late the next day the deck of Jerry's "research" boat dropped under my feet as the twelve meter wall of white flecked, gray water rose behind the stern. Up and up, towering higher than I could see, the immense wall rose as we dropped further into the trough. Finally the crest rose far above, where the one hundred kilometer per hour winds would be blowing the white froth off its top, that was something I couldn't see because of the helmet's restriction on my head movement. What would this wind be on the Beaufort scale, I wondered? Force eleven or better for sure! The wall moved relentlessly away from me, a vast mountain of water racing away from our stern and leaving us in a watery valley, surrounded by huge peaks of moving, liquid geography.

I wasn't worried about the survivability of the boat: The *Valkyrie* had

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been a completely enclosed, stress tested, air-droppable attack ship before the wave of peace came over the world and made military surplus a growth industry. She could be dropped from a plane going at over two hundred kilometers per hour, bob to the surface, and have her engines going immediately. No little hurricane could harm her. Jerry had found her the perfect vessel for our planned assault on the hurricane.

As soon as we reached the trough the deck started to rise like a rising elevator, faster and faster as another wave moved beneath us. I was forced to brace myself as the boat tipped backward on the slope of the wave. Only the strength of the clamps on my boots and the line from the reel at my back held me from tumbling off the stern. Finally we reached the apogee and were exposed to the full force of the wind that drove a solid sheet of water horizontally across the deck. The deluge obscured my faceplate and prevented any view of the surrounding seas. Of course, this close to the storm you couldn't see more than a few meters in any direction anyhow, so I wasn't missing much.

"Pressure just went below 980 millibars," the intercom crackled in my ear. "We're approaching your outer rainwall. Better get ready to leave."

"Check your gear," Jerry's voice said unnecessarily over the intercom. I glanced to my right and saw him wave one orange arm. While we were plowing our way from Charleston harbor into the Atlantic I'd already checked every item of my equipment ten times at least, and did a final check before coming out to get into position on the deck. But caution was ever the watchword for a jumper so I dutifully ran down my mental checklist one more time. With a snap of my chin I brought the heads-up displays that were projected onto the inside of my faceplate, confirming the captain's pressure reading with bright red numbers. The altitude reading below it showed us varying from plus to minus twelve meters: Since we were in the middle of the tropical depression surrounding hurricane Janice, the GPS reading would show us to be above the Earth's ideal spherical surface at the crest of the waves and below it on the troughs. Heading, attitude, speed, rate of climb, and all of the other minutiae of this venture were checked and confirmed in the display.

I reached up and felt for the oxygen bottle strapped to my shoulder, the battery pack was attached on the opposite side, and confirmed that my helmet was strapped tightly to my skull with the face mask clamps tightened down. The jump we were about to make was very much like climbing a very, very tall mountain. Up at the top we'd be at nearly seven kilometers with the air pressure down to a mere four or five hundred millibars—not too healthy for human lungs and consciousness, to be certain.

Next I tested each of the straps securing my parachutes into place, giving a tug to make sure that their lines hadn't become tangled since the last time I checked. The chutes were all

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connected, each one would pull the other as it was released through a sutliff shroud arrangement. We'd have no time to bother with release and deployment once we were on our way, so everything that could was arranged to happen without human intervention. The eight linked chutes, four in front and four behind, gave the three of us a comical look—like a group of brightly colored, rotund beetles. I reached behind me and felt the release on the hook of the take-up reel and the boot clamps, tracing the pull cord around my waist to the handle at the front, right beside my left hand. The other handle, on the right side, was for the ribbon chute, my primary deployment.

We had developed our storm jumping techniques gradually, leaping out of airplanes into thunderheads with various types of sport chutes to start and worked our way up to tackling the edges of the hurricanes in the south Atlantic and far Pacific, where they still call them typhoons despite international attempts to standardize weather terminology. Each of our jumps was designed to perfect some point of technique or test a new wrinkle in technology. Most led to the development of yet another innovation, such as the balloon chute combination that I carried as my numbers four and six.

The sails and chutes in my inventory were partly Jerry's innovations; modifications to the early Irwin Eagle parasail models. Every one of them was proven using wind tunnels and simulations that tested the radical designs. The ribs were inflated by the wind's shock wave as the sutliff pulled the deployment shroud away. This gave the sail's reinforced dacron added structural strength and turned the chute into an airfoil. The modern jumper's standard rig was a cross between a hang glider and a sport parachute, modified for the high winds you normally encountered within a storm front. They were every bit as advanced a technology as the suit's heads-up displays, and the GPS receiver in my helmet.

There wasn't much I could do about the suit, aside from ensuring that the seals were all closed and that the battery pack was firmly attached at my waist. The suits were the latest innovation Mariah had uncovered. She'd discovered the material on one of her systems searches for new technology we could use. Our suits were layers of space-age materials that embraced us like a second skin. The outside was a waterproof and thermally protecting layer that would keep most of the external environment away from our frail bodies. Their strong elastic would also, Jerry observed with his obsessive attention to detail, hold us together if we broke anything, like an arm or leg, during the jump. All the suits were colored to have high visibility in dark and stormy waters. Jerry had selected the usual international orange while I chose the sailor's survival red. Mariah, with her usual attention to style and a desire to be different, was garbed in gear dyed a flaming fluorescent pink, for heaven's sake!

Next to our skins we wore a thin

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set of underwear that would pass most of our perspiration and retain our body heat. This was just another version of the polypropylene underwear that had been around for years and was still the best thing you could have next to your body, except another body, that is.

The middle layer of the suit was the critical one. This was the micropore fabric that was the latest in survival technology. The layer was composed of thousands and thousands of cells, each of which had their own function to perform. One type would reverse the flow of heat from one direction to the other like miniature heat pumps. If the external environment was cooler than a certain level it would not allow any heat to escape from the body. If it was warmer, as it was at the moment on the deck of the ship where the temperature was nearly thirty-two degrees Centigrade, it would allow the heat to escape to the outer skin, where it would evaporate and provide a measure of cooling. A second type of suit cell reacted to pressure, filling its volume with scavenged fluid, no problem with the amount of work we'd be doing, and becoming rigid as the air pressure lowered, sealing the suit, and keeping our blood from boiling. The third type of cells were mediators, governing the range of behavior of the others and which were themselves controlled by the small computer built into the suit's battery pack. I glanced down to make sure its tiny red telltale was winking. All considered the suit was one step short of qualifying as a primitive life form.

"Why do you want to waste your time checking this stuff again?" Mariah's voice crackled over the intercom. "It will either work or not at this point. You certainly aren't going to back out now!" That was just like Mariah, fractious as hell before a jump, more so than normal, given our current situation. Jerry got picky-picky, covering his nervousness with constant confirmation that everything was in readiness while Mariah was more of a "spit on it and go" philosophy. I never could understand how the two of them had thought their marriage could succeed with such disparate styles.

Despite their different styles both Jerry and Mariah were meticulous about our preparations. Nothing was going to be used that hadn't been tested under extreme conditions a dozen times or more. Every step of our jump was carefully planned down to the most picky detail. Step by step procedures were drawn for every possible contingency and scenarios were run a hundred times to make sure we knew all the dangers Janice could offer. It was only after all the details were settled that Mariah's basic personality came to the fore; her "let's get on with it," panache.

It had been Jerry's cool head and credentials that had held off the Coast Guard until we could get our boat beyond the limit. "We are a weather research craft, fully rigged for heavy weathers," he had advised them when they hovered to tell us to turn back. That wasn't a lie. We were a fully recognized arm of the GDN Foundation, a preeminent weather

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research institution well known for its airborne sensors. Jerry had started the foundation with the profits from his parachute business and used his jumpers as mobile collection platforms. Each of Jerry's helmets collected continual readings from GPS as well as pressure. With rather exacting precision the foundation could report the precise wind flows as the jumper transits the storm. The information was invaluable, since no unmaneuvered balloon could possibly reach the places we went.

Naturally the Coast Guard knew who we really were and what we were about to do, but they had to observe the forms dictated by their regulations. Our refusal to heed their fair warning relieved them of any responsibility for whatever might occur. Once we stated our credentials and were on the high seas we were on our own recognizance, to survive or fail on our own.

I tried to imagine what it must look like from their safe perspective as the Coast Guard vessel turned back. Here I was, clamped to the deck of a heaving ship heading into the teeth of a major hurricane, burdened with nearly two hundred kilograms of parachutes, electronics, and survival gear, and ready to leap off into the wind-driven seas. *Crazy bastards,* they would probably think, wondering what motivated us. How could I explain how it felt to try for the big one, the thing that had never been done before—a complete closed circuit of a major hurricane!

The circuit was a natural progression for us. We had practiced by riding the faces of the big storms, flying before the heavy winds for the past three years. Jerry and I had skirted the periphery of the typhoons in the Pacific, bouncing around the inner rainwalls, riding the updrafts to three or four thousand meters before bailing out. Making a complete circuit of the heart of the hurricane was something others had tried while we practiced and perfected. The last three tries had resulted in two jumpers dead and one missing, all drowned or presumed drowned in the turbulent seas after having their gear ripped apart by the ferocious winds. "One must surmount the comma," Jerry had proclaimed one evening as we were planning our assault, tracing an arching line above the heavy winds and turbulence of the eyewall on the three dimensional wind model we had downloaded from the NOAA board.

A hurricane can be thought of as a concentric ring of rainwalls ranging up to a thousand kilometers away from the eye, each one a raging torus of cyclonic winds and rising thermals. The most forceful winds of the central eyewall exist at the one o'clock position to the storm's track and close to the bottom of the rising stack of warm air, the primary energy cell that forms the eye. It is the rising warm air within this cell that fuels the hurricane's fury. Sucking latent heat energy from the surface the air rises clear to the stratosphere in enormous volumes, dropping part into the quiescent eye and the rest into the overflowing storm shield. Most of the energy transfer occurs at various levels

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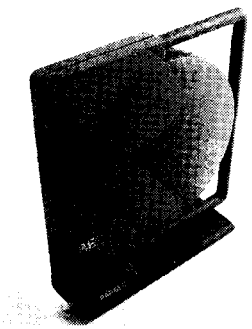

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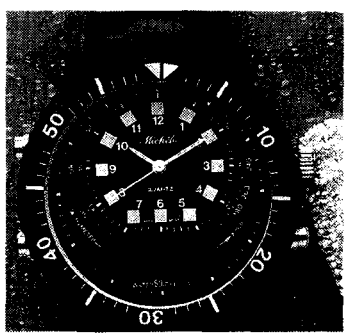

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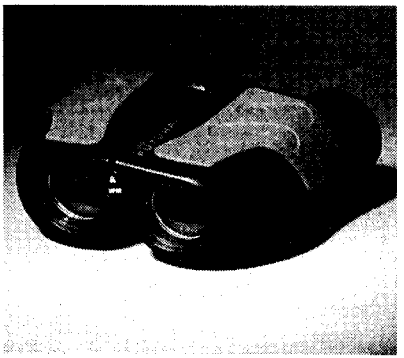

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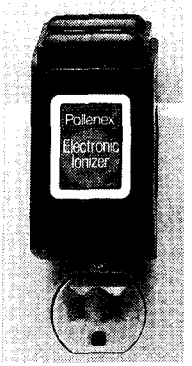

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of the stack, dropping the temperature as the warm, moisture-laden air condenses out and releases its energy.

It is as you approach the inner eyewall that the pressure gradients change rapidly and the wind speeds increase. Down near the surface the storm might have a pressure of one thousand millibars, while at six thousand meters the pressure would be down to half that, with a corresponding drop in wind velocity at any point from the center.

Over two pots of coffee and innumerable arguments we sketched out a route we could take to circle the storm and survive. We had to make use of the prevailing winds, our expertise in handling high speed wind sailing, and our knowledge of the structure of the storm.

We would try to get into position and enter on the eastern side, just inside the first major rainwall, about seventy kilometers from the eye at about the four o'clock position. We would use the updraft at that location to climb to two thousand meters and turn toward the eye before we got caught in the side draft that would take us out and back down. Using the winds surrounding the eyewall we would climb another thousand meters, and fall into the eyewall near the two o'clock spot. If our calculations were correct, and the plan worked, we would then accelerate, brush the top of the comma itself, which would give us enough momentum to spin into the eyewall. Once there we would climb the stack of upward flowing air and fight our way into the eye at about nine kilometers up. Once we were in the eye we would have a few moments of rest before fighting our way back out.

Our plan was to drift around in the eye to the eight o'clock position and dive near the surface, fight our way through the trailing eyewall—where the wind gradients were less—be carried back up to altitude by the upwellings of the trailing rainwalls and be carried around to the starting four o'clock position. Naturally the storm would have moved by this time and the same relative position would be far northeast of where we had started. Hopefully, our path would describe a long ellipse with the eye of the storm as its primary center.

The "ifs" of the plan were manifold. It depended upon our hurricane following a decent track and not recurving on itself, bending back and destroying the smooth laminar wind flows on which we depended. It depended on the storm structure having a nicely rounded shape and not going excessively elliptical on us, which would throw us far off course and make retrieval, provided we survived, difficult if not impossible. It depended on the reliability of the NOAA weather model we had downloaded and our faith in accuracy of the wind and pressure dynamics described in a dozen or more meteorological texts. It depended on our gear being the best we could get. It depended on us using every bit of skill and knowledge we had acquired over the last five years of storm jumping. And, to be honest, it depended on the power of prayer and the will of God.

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"Nine sixty millibars," shouted the captain. At the same time the long ribbon unrolled from a standard at mid-deck. I watched it whip around for a few minutes before it steadied and hung straight out a few points off our stern. The captain was keeping us into the wind, showing us the shape of the wall we were penetrating. "Launch whenever you're ready," he said calmly. How could he be so damn laid back while fighting the seas, the winds, and his common sense to keep us on a true heading, I wondered. Is he as crazy as the rest of us? The answer was obvious.

"All right," Jerry said with rising tension in his voice, "Let's make sure of everything one last time before we go. Now just wait while I—"

"Wait, hell!" Mariah said, deployed her sail and kicked free of the clamps just as we reached the peak of a wave. I watched the wind rip the small pink parasail from her front pack, lift her clear of the deck, which disconnected her from our intercom link. I couldn't see the thin strand of monofilaments from the reel that kept tension on her and ensured that she would rise against the wind. With a wind speed in excess of one hundred klicks even a small sail has enormous lifting power, equivalent to the large, low-speed parasails that they use to tow swimmers at all of the Caribbean resorts.

"God damn that woman," Jerry muttered. "OK, here I go," and then he launched when we hit the next peak. I watched the water wall build at the stern once again, feeling the boat drop away as we slipped down into the valley of anticipation. The heart monitor on the display showed my rate to be way up there, as if I had run a mile. Then the familiar elevator feeling came again as the boat started rising to the crest of the immense wave. With my heart hammering in my chest I waited for the crest to appear, one hand on each handle. There! The peak was coming. I released the clamps and the sail together, timing the emergence to match the peak of our climb.

WHAM! The sail opened with a snap as the straps pulled me forward while the reel line offered just enough resistance to force the tiny red kite above me to rise into the wind. I was yanked nearly horizontal as I instantly accelerated, smashing into the top of the departing wave and finding myself immersed in the gray water for a microsecond before emerging on the back side and begin climbing, water streaming out of my boots. The universe was a swirling buffeting mass of wind and water as my body turned this way and that, fighting the line from the reel and the straps pulling me aloft.

In less than a minute I had reached the end of the line and was flying nearly three hundred meters above the raging seas below. I could feel the snap of the automatic release going off, dropping the line from the reel and giving me to the fury of the storm. I was immediately accelerated to match the wind velocity by the fierce winds. I tried to twist around, to face away from the direction of travel, but the straps to the small sail stopped me. The altimeter showed

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me at a ground speed of just under one hundred kilometers per hour, just about even with the wind. I hit the release for the next chute and watched the wind whip the small red one and the sutliff away.

With an enormous kick of my feet I managed to turn partially around to face into the wind as my second chute tumbled and deployed. Now that we were moving relative to the wind the larger chute wouldn't be ripped to shreds when it emerged, so went the theory. The instant it filled out to shape I began hauling on the forward and eyeward lines to dip that side and steer me toward the rear of the rainwall, where the rising winds were more likely to be found. My heads-up display showed me to be rising slightly, now at about 110 meters with a ground speed of less than one hundred. I checked the rate of climb a second later and saw that it had risen a few meters per minute, which indicated that I was following the plan so far. If I continued I would soon hit the major stream of warmer air and be able to start my ascent to the top of the storm.

The big difference between parachutes and gliders is that the chute merely slows the rate of descent while the glider uses aerodynamic properties to gain lift from the wind rushing over its surfaces. The chute above me used a minor fraction of the tremendous wind force to keep itself inflated and the rest to develop positive lift. I was, in effect flying into the wind even as Janice carried me backwards to her heart.

The outer annular ring of a hurricane, our first rainwall, is a twisting torus of wind that acts just like the roller-beater on a vacuum cleaner; sucking some of the warm air beneath it into a rising stream while feeding most of it inward to the central vortex; the eyewall. Close to the center of this wall of winds there is considerable turbulence as the rapidly rising winds, which are also moving horizontally around the torus and thus describe a spiral, mix into the smoother flow of the inner winds. The trick I had to master was to keep myself away from this turbulence and stay within the rising air streams. Either the pressure gauge or ground speed indicator would tell me which direction I was heading: Inward was lower pressure and outward was higher; inward was higher speeds and outer was lower. It was a delicate balance, but one we had all experienced before. I expected no problems on this phase of the jump.

As I hung there and carefully guided the chute into the rising river of air being sucked into the storm from the surface of the raging seas below, I wondered at the calm that had overtaken me. My heart monitor showed me back to an exhilarating normal, just as if I were jogging along at a nice aerobic rate. I was now moving with the winds, leaving the relative safety of the boat far below and behind as I drew closer to the heart of Janice—her inflowing eyewall. Unassisted, her winds would take me in and down drawing me to her destructive comma and sure death. Only my skill at guiding the expanses of inflated fabric above me would over-

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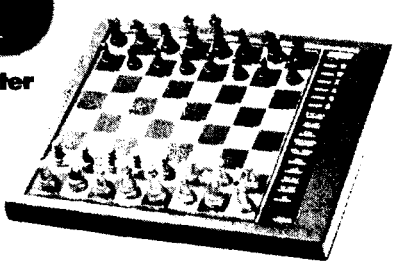

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come that event. I carefully noted every aspect of the wind and movement, checking the pressure readings each second to make sure they kept moving in the right direction.

Jerry's helmet displays were rather sophisticated derivations of the basic GPS data. To save weight, which means eliminating as many heavy batteries as possible, Jerry used a small processor to calculate ground speed, altitude, rates of climb, and position from the signals being beamed from the twenty-four orbiting GPS satellites far above the storm. The only other instruments we carried were the redundant and passive pressure gauges threaded into our suits and helmets. Within the margin of error the data on the displays were better than we could get from even kilograms of standard instruments and batteries weighing us down. Jerry's electronics only added a mere five hundred grams, half a kilo, including the batteries.

Whoops! The rate of climb suddenly dipped, indicating that I had gone too far in one direction. Struggling with the heavy straps I managed to steer back into the upward winds. Largely you had to work by feel and hunch where reading was impossible through the shaking and rocking the winds caused. The turbulence wasn't nearly what I expected to find farther in, but was still considerable and took all of my strength to overcome. If I let the wind take control the buffeting could become more than I could handle. At this point Janice had to be handled with some delicacy, like an ex-lover at the end of an affair.

Suddenly there was that empty feeling in the pit of my stomach as I started climbing at an increasing rate. The rate of climb was now reading in meters per second, not minutes, and my horizontal speed was way down to a mere eighty kilometers per hour. In my mind's eye I recalled the geometry of this part of Janice from our model. The winds would be rising on a sixty or seventy degree angle from below as they circled Janice's center, being pulled up into the vacuum above. The pressure readings dropped with every few meters of altitude. When the rise started I had seen something around nine hundred millibars. The figure was now closer to eight hundred. I confirmed with the altimeter reading that I was already at the two thousand meter level, which was right on the profile. To maintain my place I started a lazy track left and right, tending more left than right to accommodate the curvature of the winds. You had to be cautious at this level. With no reference points in sight you could have a serious problem with orientation; the old diving syndrome that was the bane of high altitude hang-gliding. With this level of wind force you could easily be flying upside down to the ground, or any other orientation, for that matter. Only the helmet display kept me oriented as to up and down. I'd learned over the years to completely ignore my body's signals, since they could kill you if you trusted them too far.

I keyed the relative display onto the left side of the display and saw that I was still around sixty-five klicks

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from the eye, which again was right on the profile. I continued my sweeping tactic, keeping my eye on pressure, rate of climb, and speed.

At seven hundred and fifty millibars I cranked the oxygen flow into action and took a heady whiff to clear my head. Above this level the headaches and nausea from oxygen deficiency from my exertions would start without the breathing mask. The storm wasn't too bad at this level, over three thousand meters, especially since most of the moisture was traveling along with me. I watched the pressure drop, drop, drop as I continued to rise.

A long while later, somewhere along about six hundred and fifty millibars, visibility improved momentarily and I thought I saw a flash of color beside me, but wasn't sure. Suddenly I noted that my ground speed was increasing, as was my calculated distance from the eye. Without warning I had been thrown out of the rainwall stack and was being swept by the cyclonic outflow into the intermediate cirrus formations, from which there would be a major downflow. For some reason Janice had chosen to be contrary and forced me out of her rainwall far sooner than expected. The model said that I should have had another thousand meters of altitude from this formation!

I tugged the lines around and started to sail back eyeward, losing altitude even as the storm blew me backwards. Suddenly the rate of climb indicator went crazy, rising swiftly and just as quickly dropping. Somehow I had gone right through the rising flow and emerged into the back of the rainwall. I started to lose altitude immediately.

If I didn't do something right away I'd be swept too quickly into the eyewall to clear the comma. I released the parasail and dipped with a stomach churning twist as the ejection pulled out the next offering in my assault on Janice. I could feel the wetness at the seat of my suit as my bladder let loose with the jerk of acceleration. Above me a bright red balloon chute was expanding. With my left hand I reached over and twisted the knob on the tank anchored to the straps, feeding an extra measure of gas into the expanding balloon. In a few seconds the arrangement had achieved positive buoyancy and began to lift me. The ground speed increased enormously, rising to nearly 150 kilometers per hour. With a heave and twist of my shoulders I turned the harness so that the wind was striking me from directly ahead. This would let the cyclonic winds draw me inward even as I gained altitude.

The balloon chute was Jerry's most significant contribution to jumping, and probably made it possible. Kotsch called it the "ugliest damn flying device ever invented" and most people who weren't jumpers agreed with him. When you are dealing with hypersonic and turbulent winds of a major storm most standard designs just won't work. The balloon chute looked like a misshapen sausage that had sprouted stubby and assymmetrical wings at various points. The bulbous top faired back in a tear-shaped

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cross section while the lower cross sections were more nearly elliptical. The control lines were tied to each set of "wings" so they would move in concert and bend the balloon at the same time. Ungainly as it looked it did provide both lift and control under extreme wind force conditions.

Soon I was climbing through thin wispy clouds that had to be the cirrus from the rainwall stack. For a moment I broke through into some clear air and could finally see more than a few meters around me. Matter of fact, due to some anomaly of storm winds I had entered a volume relatively free of rain and cloud.

Off to my right I could make out the convoluted shape of the rainwall and, far above it, the bottom of the outflow's cirrus layer. In between there was clear air, an area of seeming calm that was belied by the rapidly mounting numbers of my ground speed indicator.

Far off ahead of me was a brilliant spot of orange. I could actually see Jerry's chute preceding me along the path. He appeared to be a little below me and closer to the inner wall. Who had made the mistake in altitude, him or me? Or was our difference an illusion from the lack of fixed reference points? Was I in a feet-down attitude or hanging on some angle? Before I could decide the orange dot disappeared into the cloud.

Down below me was a canyon of dark menacing cloud where the outer rainwall met the bottom of the eyewall. Down there chaos reigned supreme, tearing everything that came in contact into shreds from the extreme forces of the wind and water. The balloon chute was lifting me higher above it. Although I had gotten that brief glimpse of Jerry I still had seen nothing of the bright pink flash that would mark Mariah. Was she ahead, behind, above, beside, or below me? There was no way I could tell.

Our intervals should have spaced us out with several hundred meters of vertical separation, but the variant winds, choices we had to make, and random wind events meant we'd tend to stay close together, but not too close. The odds of coming near enough to see were fairly slim. Nevertheless, it was worrisome not to know where both my partners were at the moment. The fact that I had seen Jerry below me was unsettling because it meant that I had gone beyond my planned envelope.

My ground speed was now topping 200, and showed no sign of decreasing. Pressure was down to a mere 620 millibars—Janice was a real bear of a storm! At this altitude the winds were more organized into a smooth laminar flow, absent much of the turbulence that would be present below. Still, with winds climbing to over 250 klicks; this was not an area to lose one's concentration.

Wind force is not a linear relationship: The force of the wind increases with the *square* of the velocity. A thirty-knot wind has nine times the force of a ten knot one, and the wind carrying me along through the clear air was in excess of 200 kilometers per hour!

The altimeter told me I was nearly

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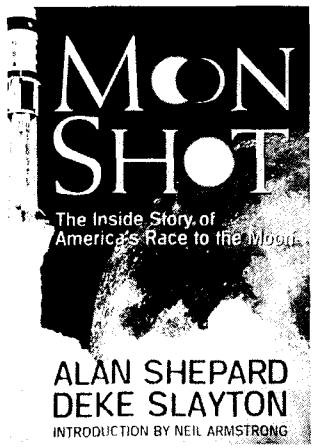

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at the peak of my climb, halfway between the rainwall and the eyewall. With some regret I blew the balloon and deployed my third chute, a small one designed for the extremely high shear forces ahead of me. From here I planned to ride my chute down to the outer edge of the eyewall and skim the top of the comma. I glanced at the time; nearly two and a half hours had elapsed since I left the relative safety of the boat far, far below and even farther behind me. Just like in my previous jumps time seemed to compress enormously when I was working the winds. Only the first touch of fatigue in my arms told me that the clock must be correct and that I had been working for that long a period.

Ground speed was still going up as the cyclonic wind effect drew me closer and closer to the eyewall. I didn't like the way the altitude was going down. It was too damn fast to suit me. With considerable effort I tugged the leading edge of the sail to gain some lift.

That was a mistake! "Stupid, stupid, stupid," I yelled as I fought for control. The clear air had deceived me into thinking everything was normal and I had reacted accordingly. In these wind force conditions I should have lifted the eyeward edge to gain altitude, using the greater wind speeds on that side to provide lateral lift. But I hadn't and now I was paying the price as the chute started to oscillate back and forth, spilling wind with each twist and turn. Worse luck, I was losing altitude and dropping back into the turbulent air once again. I shifted as much weight to the eyeward side as I could and felt a response, a bit of a lift. Suddenly the lift became extreme as I swung closer to the eyewall. Somehow I had been caught in an eddy that was drawing me toward the immense dark wall of cloud.

Pressure was up to 700 now, meaning I had dropped uncomfortably close to the top of the comma, the most dangerous area of the eyewall. What could I do? The closest reachable updraft was inside the eyewall. The only choice here was to minimize the proximity to the severe winds closer to the outer parts of the eyewall. I glanced at the ground speed and felt a sudden shock: The reading was over 300 kilometers per hour. I was being sucked into the ultra high winds of the comma itself!

There was a sudden flash of color coming from my right, just before something hit my legs and spun me around. When I recovered from the sudden shock of the unexpected I found that something heavy was smashing repeatedly into the side of my head and my feet were entangled and being twisted this way and that. For a second I felt that I was tumbling head over heels; being pulled by the chute in one direction and dragged in the other by something unknown holding my legs in its grip. For some reason my right shoulder wasn't feeling the pressure. I grabbed for the control lines on that side and my hand met empty air—the strap had broken and I was dangling by one line. A quick glance above showed the remnants of the chute twisting

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and turning like a candlestick above me. I assumed that that direction was up, since you can never trust your senses in these situations and the altimeter reading showed that I was still dropping. Panic seized me momentarily: I had to do something to gain altitude.

In a flash of analysis so rapid that I could only reconstruct it in retrospect I figured out what to do. The next chute in front was to be the conventional chute I was to use to navigate the eyewall. In this situation deploying that one was sure suicide; it would provide far more lift without control. With it I wouldn't be able to clear the comma. The chute on my back pack was another balloon, the one that I was to use in the eye. Well, I'd handle that problem later, right now my concern was getting above the growing mass of dark cloud beneath my feet. If that chute could hold in this wind it might, just maybe, give me the lift I needed to clear the worst of the comma's winds. The balloon chute was the only option, risky in these winds, but an option.

In desperation I yanked the handle to deploy the balloon, watching its sutliff rip away the torn shroud as well as the unused chute, and risked a look below me. With a shock I saw a fragment of bright pink fabric fluttering around my legs. Somehow, against all odds and our careful planning, Mariah and I had smashed into each other. But she was supposed to be far above and ahead of me: What chances had she taken to cross my path? Then I recalled seeing Jerry far below and my fear that I was out of position. Dear Lord, I thought in a quick prayer: I hope I didn't kill her!

The balloon was never designed for such winds and was a bitch to control, whipping right to left like a manic pendulum. I watched the altimeter readings, willing the numbers higher and higher as if by sheer mental pressure I could do what the balloon was attempting. I felt a icy wetness on my neck where whatever it was had been hitting me. I stole a quick glance to my right and saw that the air bottle had come loose and was swinging free by the hose. Was my helmet broken? Was I bleeding from the ear? No, the chill on the side of my head was due to the faceplate swinging free, exposing my face to the freezing winds. With one hand I slammed it shut and pressed the clamps tight. Already the cold had frozen the exposed skin on my cheek, meaning I'd lose some of it. Did that really matter when I was dangling nearly four kilometers high over a monster hurricane that would smash me like an insignificant bug? I concentrated on controlling the chute to whatever extent I could and prayed hard for divine intervention. The altimeter fluctuated rapidly, alternatively showing marginal improvement in altitude and sudden descents into the maelstrom as the comma drew closer and closer.

Suddenly I realized that I wasn't going to make it. Janice was the one who would finally give me the death that Billie swore I had been seeking. Well, I never thought it would end this way; falling miles down with a tail of flaming pink behind me. Would

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I have been in this fix if I hadn't secretly wished for my own death? Would I be sailing clear above the raging storm instead of being sucked into the core if I didn't yearn for Janice to kill me? Somehow the torrent ahead and the emotional mess of my self-doubt merged. Where could I have steered differently and averted the problem? Was there something about me that allowed this to happen or had I been the captain of my own fate?

The balloon shuttered with vibration from the buffeting of the heavy winds as we rose, straining every strap until they sang with tension, threatening to tear away in the howling wind. I couldn't tell if we were climbing or falling. The hammering vibration made it impossible to read the numbers on the faceplate. I was being drawn into something over which I had no control, none whatsoever. Billie was right; I was stupid to try to jump a hurricane. Maybe death would be an easy way out of my messy situation, I thought fleetingly. But then, I didn't really want to die. I didn't really want to end my life in the middle of a stupid Atlantic hurricane. I wanted to beat this bitch of a hurricane; that was *my* motivation. I wanted to show Janice that I wasn't something that could be tossed about. I could get out of this, I could make it back to safety and life!

With the strength born of desperation I hauled on the control lines, forcing the balloon about and forward to the winds. I could feel the tiny wings bite air as we swooped and soared in the heavy winds. My arms ached as if I had been pressing weights for hours. My fingers were getting numb from the grip on the lines—crucifixion syndrome, I dredged up from somewhere in the depths of my jump schooling. And then, just when I thought it would never happen, despite the strains and wobbles, we began climbing. What's more, we were climbing at an ever increasing rate. Now that my attention on the altitude was less focused I noted the closeness of the immense cloud formation of the eyewall. Well, I had finally gained a little lateral control at this point. Down this close in the comma the gradients in wind speed were such that there was nearly a kilometer per hour difference in speed between the two sides of the balloon, which is to say that we were being sucked into the wall, willing or not. I braced myself for the turbulence I knew was awaiting me. Thank God the winds were lessening, if dropping back to a *mere* three hundred could be considered less.

The darkness of the eyewall enclosed me like a thick fog. No, that's wrong! Fog is a gentle mist. The eyewall cloud was a horizontal sheet of wind driven, microscopic bullets. I could see the horizontal striations as we "drifted" through the wall. Ground speed was now down to nearly two hundred fifty with an altitude of nearly seven thousand meters, barely above the worst of the comma's fury. Where was I in terms of the launch ship? The chronometer said I'd been aloft nearly four hours at this point. Let's see, Janice would have moved northeast about thirty ki-

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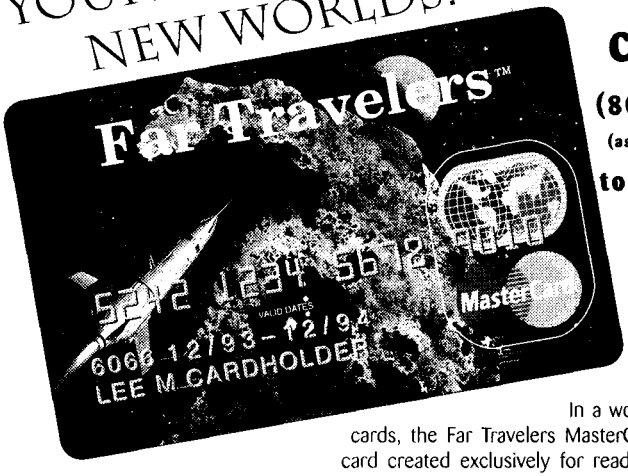

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lometers in that time as I followed my spiraling, rising ride to the top and would move another thirty or more as I worked my way back down to the surface.

There was an insistent upward tug on the lines and the altimeter readings started increasing rapidly. I must have reached the inner uplift of the eyewall. I let the strong updraft carry me upward, my ears popping with the sudden change in pressure. Lord, the altimeter was rolling so fast I could barely track the changes while the pressure was dropping at an astounding rate. A chill swept over my body as the surrounding temperature dropped; the reading said it was minus forty and dropping! The ascent rate was more than could be accounted for by the buoyancy of the balloon. After I gained another five hundred meters the wind speeds were down to a reasonable one hundred fifty kph. The force of the upward wind stream was such that I could easily be swept to the top of the storm, twenty six thousand meters above the Earth, well beyond the capabilities of my survival gear. I had to get out of the upward air stream if I was to survive.

The balloon was now a hindrance to my escape. The positive buoyancy was permitting the storm winds to lift me higher and higher. If I let it go perhaps the force of the wind would be insufficient to hold me up. Without another moment's hesitation I cut the balloon free and tumbled helplessly down, the altimeter rolling backwards at an astounding rate. When the altimeter said I was below the thirty thousand meter mark I let out the big rogallo that was to be my escape chute out of the eye. It took less than a minute to unfold and lock itself. Finally the fabric of the chute tugged me into a stable attitude and I oriented myself to the surface. As soon as I regained my balance and a measure of control, I lifted my legs and clipped the aft line onto my heel, pushed the control lines forward, assumed a horizontal attitude, and converted my rogallo from a chute into a glider. At the same time I put strong pressure on the right side and turned to have the wind at my back. The acceleration was exhilarating as speed picked up again. But altitude and control weren't my objectives. The idea now was to gain enough speed to blast out of the upwelling stream and reach the relative calm of the eye itself. Down, down, down I pointed the nose and felt the speed build and build as we dove faster and faster. The pressure readings showed me the route as I bore onward through the lightening mist.

Suddenly there was a burst of sunlight around me. Then I caught snatches of blue sky. I turned to head for the brightest patch in the mist and broke clear of the wall. But I hadn't reached the calm eye just yet. On the inside of the eyewall was more of the swiftly ascending warm air that fed this beast. The rogallo tipped, pulling me upward. Despite my efforts to shift my weight forward, the wind was too strong. I couldn't fight it.

If I didn't escape it would carry me back into the main flow I had just left. I leaned to the right to see if I could

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steer a little and had no effect on our course. Attempts to lean to the left also met with no success.

Then I remembered the way Jerry and I had used the hydraulics on the Youg when we first met Mariah. Rather than fight the flow of the water we had let it have its way and used its force to our advantage. Quickly I leaned backwards, spilling the wind from the rogallo and feeling our rise stop at the start of a slip. I let the altimeter fall two hundred meters before leaning forward and letting the wind control us once again. The maneuver had moved me a fraction closer to the center, but there was a fluttering in the control that I didn't like. I repeated the maneuver and moved even closer, the fluttery feeling of the control lines was growing worse with each repetition. Finally, after six repetitions I was finally gliding in clear air, ground speed at a measly twenty kilometers per hour, blue sky above and a few puffy cumulus below me. I glanced at the wing above and was astonished to see its tail a shredded mass of streaming ribbons. It wouldn't be much of a glider in the soft winds of the eye, that was sure.

From this vantage I could see the inner foot of the eyewall. I had come out about twenty degrees beyond it, close to our planned exit mark by some quirk of fate. I glanced around, hoping to see Jerry's orange or Mariah's pink balloons, praying more than a little for a sight of pink, to be honest. Despite the turbulence and buffeting we had planned to exit close by the same position, barring accidents, I added ruefully. I looked around again, saw nothing but clear air.

At this point on my flight plan I should have had my balloon deployed and been drifting gently southwest on the prevailing winds of the eye toward our exit route. Jerry had dreamed up this drifting strategy as a way of giving us some respite and preserving our strength for the effort to break out of the eye. But I had blown that leisurely option. For now I had to ride my torn rogallo to the exit point against the winds, in the opposite direction, overcoming the torn fabric fluttering above me, and fighting my body's demands for rest. I had to keep away from the eyewall winds, and be alert to the deceiving calm of the weather in the eye the whole time. I would hit my exit point in less than optimal shape; that was sure.

My strategy was to continue to use the uprising wind to overcome the loss of lift of the rogallo. I would steer back into the upwelling air and gain altitude even as it drove me backwards. Then I would get out and glide across the chord of the eye and repeat it. With each try I should progress a few kilometers or more, just like tacking a sailboat; two forward on the glide and one back on the climb. Ideally I could lose just the right amount of altitude to be at the right level when I had to start my return route.

Two hours later time began to decompress rapidly. Had it only been two hours of endlessly repeating the climb and glide? Seemed like ten or more. Arms are really getting heavy,

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having to haul the lines all the time. Can't rest though; have to make it through. My leg was suddenly cold as the suit tried to adjust for the sudden heat and moisture that relief of my bladder had caused. This virtual icicle in my crotch kept me from drowsing for a short while, but soon I was back into a semi-dream state, neither fully awake not completely dozing.

"Why are you fighting me so much?" Janice whispered in my ear with a silky, sensuous voice and caressed my cheek with a cool brush of her hand.

"Because I love you," I replied calmly, wondering why I couldn't see her.

"I can't love you back if you keep fighting, you know," she went on with a husky, inviting tone to her voice.

"No, yes. I won't let you do that. I can't just stop and let you win."

"Come on," her sexy voice continued to whisper urgently. "Why don't you just let yourself relax and let me take you in my arms? Come on now. Please," she implored. I could feel her tears running down my cheek where they merged with my own. For a second I felt myself surrendering, welcoming the warm release that sleep in her arms would bring.

A chill ran down my neck and I shook my head. Those weren't tears on my cheek, they were icy cold rain drops that were running into the suit. The damn face mask had come loose again. I flipped it close, pressing the broken clasp as hard as I could to seal it. Damn, I had drifted too close to the wall again as I had nodded. I twisted my body and dove toward safety once again coming fully alert. I reached back, gave my air bottle a boost, and bit down hard on the mouthpiece. Hallucinations were indicators of carbon dioxide build up. Have to be careful about that. I bottomed out of the fall and turned back to enter the updraft once again.

The four o'clock position wasn't close and I was at my physical limit for managing the lines of the rogallo. It didn't matter whether I was in the right place or not. I had to get out of the eye and back to the surface while I still had the strength. I decided to make the final dive to where my one and only chute could be deployed. I glanced around once more, hoping to see either the chutes of Mariah or Jerry coming close and was disappointed. Were they both lost in the storm? Had Mariah failed to clear the comma after our brief encounter and been dashed to her death? I sincerely hoped not, feeling more than a little at fault. But there was little I could do about it at this point, suspended above the back end of the hurricane with nothing holding me up but a few plastic pylons and a rapidly deteriorating strip of fabric. I drove thoughts of Mariah from my mind as I concentrated on climbing as high as I could and working my way into the eyewall once again.

At this altitude and position in the eye the transition out wouldn't be nearly as difficult as my entry. I topped out with the rogallo at twenty one thousand, well above my planned level, and pulled the release for the last small chute, letting the rogallo go with the winds. The added strains of

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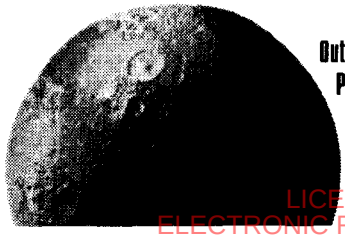

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the winds in the wall would have destroyed it instantly and, instead of being the proper vehicle for going through the wall it would have been a suicide glider. It was a relief to have my feet drop back to their normal position and feel my body supported without having to strain my arms, legs, and back.

The eyewall on the trailing edge of a hurricane is considerably less ferocious than the leading edge: Wind force is a quarter of the leading edge and the wind speed gradients are far less steep. Neither are there the heavy force upwelling wind streams that I had encountered a thousand years ago, was it only two hours previous? As I started the descent the ground speed climbed back toward two hundred with heavy buffeting as I hit the transition layer. I hit the upwelling and watched as the altitude numbers grew larger. With the smaller chute I had to get much higher than I had planned so I could make the horizontal distance to get beyond the major rainwall.

Up and up I went, waiting until the altimeter showed that I was over fifteen thousand meters. Even the tiny heat exchangers in my suit couldn't hold back the bitter cold at this altitude much longer. When I could stand it no more I tipped the chute, blowing the pillow of wind beneath it and steered away from the eyewall. Suddenly I was dropping at an accelerating rate as well, as the small chute left the stack and started screaming toward the surface. In less than half an hour I would drop from altitude and hit the rainwall where I could expect a little more lift before the long glide as far from the center as I could get.

It was a clear dive from the outer rainwall's stack, not much different than a hundred practice dives I'd made in stormy weather. I kept the lines taut as best I could. Both arms now felt like lead weights and my hands were so cramped from holding the lines so tightly for so long that I could barely feel them at the ends of my arms. I weaved my wrists into the webbing of the straps, a dangerous practice, but necessary considering my physical state, and used whole arm leverage to control the lines. My shoulders, already bruised with the constant beating of the straps, ached with the added workload.

By the time I hit one thousand again my ground speed was down to a mere seventy klicks. For the past five minutes, I had been falling through heavy, rain-driven cloud, the back outwelling of the eyewall. I twisted in my harness to glance ahead and caught a momentary glimpse of the rising sea. I freed my wrists and dangled my hands at my sides, willing the blood and feeling back into them and wincing with the pain when it did. Hoping that brief respite was enough for what I next had to do, I gripped the lines and braced for the surface turbulence, knowing I would have to fight my way through it or be dragged back into the storm's center.

After a few moments of sheer fright as an unexpected downdraft of cold air sent me plummeting toward the surface at nearly a hundred meters per second, I broke out of the clouds

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just above the foaming water. Ground speed was now down to fifty again, a relative walk compared to all I had gone through. Now it was dip and glide, dip and glide, ever proceeding outward toward the open sea, the ship, and Jerry and, hopefully, Mariah. The gentle motion was relaxing, like a cradle, where the baby sleeps. Sleep, that would be nice; just to close my eyes for a moment and. . . .

With a start I opened my eyes and saw the water immediately below my feet, churning into a froth from the surface winds. In a few seconds I was going to hit and be in the drink. What was it I was supposed to do? Oh yes, I released the straps for the excess gear, feeling it fall away from me. Suddenly my feet were being dragged through the waves as I skipped over the surface of the ocean. With a final sigh I released the chute and fell into the sea. The water closed over my head. I had returned to the home of my watery ancestors. I closed my eyes, too exhausted to fight my way to the surface.

The seals on the floatation gear inflated automatically when I failed to pull the tabs and brought me to the surface. I cracked the mask and inhaled a heady breath of damp, salty air: It was wonderful! The dashing of cold Atlantic water through the open mask roused me from my stupor and filled my mouth with bitter brine. I slammed the mask shut, trapping considerable water inside that sloshed back and forth as I bobbed in the waves.

At this point there was nothing I could do. The salty water was already activating the distress beacon, sending a coded message to a satellite far above that relayed it to *Valkyrie,* who would, with luck, be able to find me in this heaving seascape of waves and wind. All that I could do was wait and hope. Sometimes you just have to put your trust in other people.

Jerry and Mariah both survived the jump. Mariah lost most of her gear when she tried cutting too close to the wall and blew her rig near the top of the comma. It was her cast-off gear that had struck me, not Mariah herself, I was relieved to discover. She barely managed to recover control with the small chute after she had fallen nearly four thousand meters. She hit the water just beyond the worse part of the storm, and had been tossed and tumbled in the wind-driven, foamy mountain range of waves for a full day before anybody could get near enough to recover her. A fall that long gave her a lot of time to think about other things, even while she was working hard to figure out how to save her life. Ever after that experience she has not been quite the risk taker she used to be.

Jerry made it through the whole profile, encountering no problems as he gamely worked his planned route to its logical conclusion. I have no doubts that he enjoyed every single minute of having everything come out exactly as he foresaw it.

I kept away from jumping for a couple of months, not easy since we three were suddenly the darlings of the jump community; targets of every para-journalist in the world. NOAA

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paid a nice bonus for the data from our computers and put that and our model out on the Internet for every jumper in the world to examine and copy. Now that someone had done it everyone could build on the experience. Sort of like putting pitons in the cliff face to mark the trail up Everest.

The next season our fame slipped away when Kit Strock's team used my experience with the balloon rig to travel the primary energy cell's upwelling winds, that's nearly two million metric tons of air per second, clear to the top of the stack—the freaking stratosphere, for God's sake; fifteen miles of vertical climb by her archaic measures—and returned, less a few toes and fingers to be sure, but alive! Kit was a fool, but a daring one, I'll give her that.

To this day I wonder at my conquest of Janice: Did I successfully conquer the storm that raged around me or was I just lucky that I managed to maneuver myself out of serious trouble? For that matter, do any of us really have control over the momentous forces that shape our lives or are we merely content to tack with the wind and make the best of what is offered to us?

Mariah and Jerry called last week. They want to know if I'd like to go with them to Hawaii in the fall. They are thinking of trying some sustained jumps in some of the big typhoons that grow in the South Pacific. They've got to be even crazier than before to suggest that I'd do something that stupid.

I don't know if I should call back or not. ■

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Mia Molvray, Ph. D

GAMMA RAY BURSTERS: UNEXPLAINED LIGHTS IN THE SKY

When you have to work too hard with the shoehorn, it may be that the shoe simply doesn't fit!

Gamma ray bursters were first noticed in the mid-1960s by military scientists looking at data coming in from the new Vela satellites that had been lofted to help verify whether the Russians really were abiding by the Test Ban Treaty of 1963. Since nuclear explosions are highly energetic events, they release gamma rays. The new space technology could scan Earth for bursts of gamma rays, and thus discover when tests were carried out, and how big the blasts were. The Cold War was in full swing, both sides were arming for Mutually Assured Destruction, and it was essential to know just how far the other side had gotten.

It's easy to imagine the consternation at headquarters when word came in that not only must the Russians be cheating, they already had nukes in outer space! But the idea that the Russians could have developed space-based nuclear capability without any word leaking back to the U.S. was so implausible that the data were checked and rechecked.

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By 1967 the military knew that these strange bursts came from beyond the Solar System. How far beyond, or why, is still unknown. The bursters were declassified in 1973, and their distribution in the sky was and continues to be mapped, and their energies recorded, but that is all we know about them. Speculation abounds, of course, and includes violent events associated with neutron stars, black holes, or even antimatter.

However, all these ideas require tailored assumptions, and one idea that may fit hasn't even been considered. The first notion, in the 1960s, that these were someone's spaceships, may turn out to be right—except that they don't belong to the Russians. Given the characteristics of bursters, the hypothesis of alien spaceships is as plausible, perhaps more so, than some of the other ideas put forward. Of course, that requires the acceptance of aliens as plausible, and therein, no doubt, lies the problem.

The assumption that aliens are improbable doesn't really appear to square with current knowledge. Astronomical data indicate increasingly that planets are common around sun-like stars. Water is a reasonably common molecule, and the likelihood of liquid water at the appropriate distance from a star is good. Paleontological data show that life arose almost the (geological) minute the last heavy meteor bombardment stopped. Indications of life appear so quickly that some think it may evolve very easily in liquid water, and may even have done so several times on Earth, dying out during successive heavy bombardments until they finally stopped. Once life arises, evolution to fill the various available niches appears inevitable. If none of these events are unlikely, the only major uncertainty is whether tool-use is likely to advance to the level of interstellar technology. In my view the probabilities imply that those who will not consider the possibility of alien technology are the irrational ones, not vice versa.

I'll go into the pros and cons of the "acceptable" ideas, and then turn to the "unacceptable" idea: that, just maybe, some of the bursts come from the interstellar engines of a starfaring people.

GAMMA BACKGROUND

Gamma rays are produced in nuclear reactions or in transitions between nuclear states, typically have shorter wavelengths than ultraviolet and x-rays, and include the most energetic forms of electromagnetic radiation, with energies usually between 100 kiloelectron Volts (keV), or 10^5 eV, and 10^{15} eV. A large dose of photons with 10^{15} electron volts of energy would not merely tan, but would kill a gamma-sunbather in moments. These highly energetic photons are produced by interactions between fields (magnetic, gravitational, electric) and high-energy charged particles (electrons, protons, or charged subatomic particles). The fields energize and constrain the particles, forcing them to interact, resulting in high-energy collisions that release specific subatomic particles

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and photons, including gamma rays, with characteristic energies. The particles and photons released allow scientists to work backward and deduce precisely the reaction that produced that particular pattern. For instance, the presence of hydrogen, helium, and 12.8 MeV (megaelectronvolts) of energy indicates that nuclear fusion of positive hydrogen ions is occurring following a specific chain of reactions:

$$^{1}_{1}H + {}^{1}_{1}H \rightarrow \beta^{+} + \nu + {}^{2}_{1}H + 0.42\ MeV$$

$$^{2}_{1}H + {}^{1}_{1}H \rightarrow \gamma + {}^{3}_{2}He + 5.49\ MeV$$

$$^{3}_{2}He + {}^{3}_{2}He \rightarrow {}^{1}_{1}H + {}^{1}_{1}H + {}^{4}_{2}He + 12.8\ MeV$$

An observer who saw the final results would also know that a gamma photon had been produced in the intermediate step, and that a beta particle, a neutrino, a deuterium ion (hydrogen ion with two neutrons), as well as 0.42 MeV of energy had been produced in the initial step. Similarly, an observer who saw a release of energy at 511 keV without any other radiation or particles would know that an electron and positron (antimatter electron) must have collided, since these two annihilate each other completely and release that precise amount of energy.

Gamma rays are produced in nuclear reactions, including fission in nuclear power plants or radioactive decay, fusion in nuclear bombs or stellar interiors, reactions in cyclotrons where the particles are speeded and constrained by magnetic fields, and more exotic events such as matter-antimatter annihilation.

Our atmosphere is not fully transparent to any wavelength shorter than visible light, whether ultraviolet, x-ray, or gamma, and hence astronomical objects emitting gamma rays could only be studied easily once orbiting satellites were available. The earliest ground-based studies were carried out using Cerenkov radiation, a radiation shock wave generated by a charged particle moving faster than the speed of light in a medium, but both the number and quality of observations were necessarily limited. The state of knowledge advanced with high altitude balloon studies, with incidental data from spacecraft launched for various purposes, such as solar observation, and with sporadic data from satellites launched to study high energy phenomena, but only for a few days at a time. The real explosion of information came with orbiting satellites able to perform continuous observations. There are currently two civilian satellites monitoring these frequencies: the Russian Granat, launched in 1989, and the US Compton Gamma Ray Observatory launched in 1991.

BURSTER BACKGROUND

The Compton GRO has several instruments on board for studying the high energy Universe, but the appropriately named Burst and Transient Source Experiment (BATSE) in particular finds gamma ray bursters. Its eight modules facing out in eight directions conduct a continual all-sky survey (except where its view is blocked by Earth), recording a burst candidate whenever two or more de-

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tectors simultaneously note the gamma count rising more than 5.5 standard deviations above the background. As a practical approximation, this means there is much less than a 1% chance that BATSE is mistaking background gamma rays for a burst event, and that the background level at the time of an event must be taken into account when determining its intensity. This instrument does not make images; it records the energy, duration, and direction of burst events, and allows spectra to be calculated.

BATSE has expanded our knowledge of gamma ray bursters enough to make us realize how little we know about them. About 800 bursts occur per year, and the typical burster blooms in a few seconds, radiating nothing detectable except gamma rays, and disappears after a few seconds or minutes. For a high energy event to happen so quickly, the source has to be very compact, theoretically no more than a few hundred kilometers across, or it would take too long for the reaction to propagate through the whole mass.

In the two years of data so far available, BATSE has shown us that bursters have the following characteristics:

*They are isotropic, that is they are distributed throughout the sky.

*There are fewer weak sources than expected.

*They have differing time profiles.

*They do not repeat, that is, bursts are always coming from different places, never from the same place repeatedly.

*There is no other associated radiation, with a few exceptions.

THEORIES ABOUT BURSTERS

Isotropic Distribution

The distribution of bursters throughout the sky (Fig. 1) is really what has astrophysicists scratching their heads. They know intense nuclear reactions produce gamma rays, they know that the energies and field strengths needed are most commonly found on neutron stars, and so they were pretty sure that the bursts should be associated with neutron stars in some way.

Some scientists favored the idea of binary systems, with a neutron star pulling in ionized hydrogen and helium from a lower-mass companion along its magnetic fields, funneling the gas to its poles where the gas builds up until explosive helium fusion finally starts, releasing a sudden burst of gamma rays. Others suggested that random chunks, such as asteroids or passing planets, attracted by the star's immense gravity, accelerate toward it so rapidly that the final collision happens at a significant fraction of the speed of light, generating the rays. Some even suggested that the chunks could be antimatter. Yet others thought it might be the sudden release of energy from a massive neutron starquake.

The problem is that neutron stars, strange as they are, occur within galaxies, like their more ordinary siblings. Since we are near an edge of our Galaxy, and the Galaxy is flattened, events confined to the Galaxy are concentrated in the strip formed

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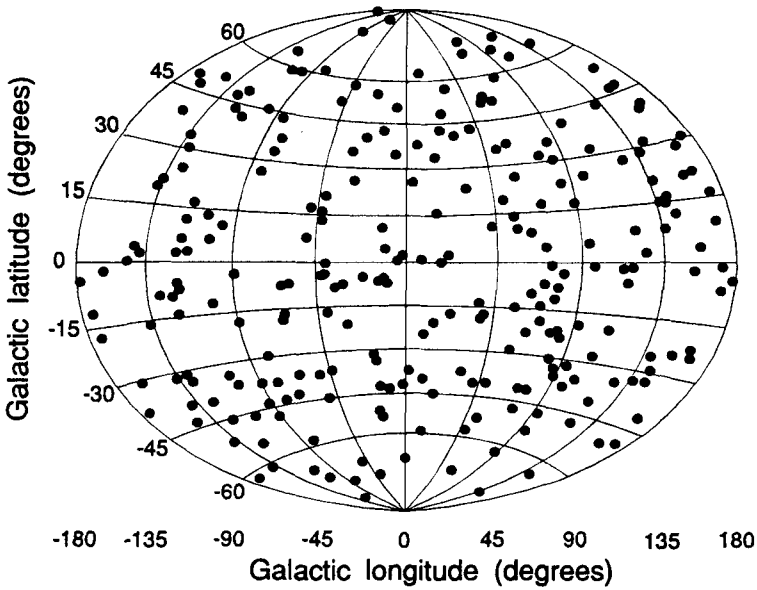

Figure 1: The angular distribution of 261 bursts in galactic coordinates. (Redrawn from Fishman et al., 1993)

by the Milky Way. The early data on gamma ray bursters showed them more or less evenly distributed in the sky, but it was assumed this was only because the data were too patchy to show the true, disk-like pattern. Once BATSE showed that bursters really were distributed throughout the sky, the neutron star theories no longer fit the data.

There are two ways to have an even all-sky distribution. Events that are so close to us they fit within the one thousand light-year thickness of the Galaxy in our neighborhood will appear to be omnidirectional. On the other hand, events on a cosmological scale and out at the edge of the Universe will also appear to be evenly distributed. Of course, if we receive a given amount of radiation in a gamma ray burst from right next door, the source must be comparatively weaker than if that same amount of radiation was part of a burst whose photons had been spread over the whole Universe. So, to understand what sort of events are causing the bursters, it is essential to know how far away they are.

Distances to Bursters

Little direct evidence exists at this point about how far away gamma ray

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bursts really are. The only direct measurement occurred by happenstance in the late 1970s, when two of three interplanetary spacecraft detected a few bursts. The distances between the craft were sufficiently great that parallax measure of those few bursts could establish that they had to be further away than 100 astronomical units. Currently Ulysses, and BATSE itself, can detect bursts, but location data from the interplanetary spacecraft will not be available for another year. The late, lamented Mars Observer would have provided yet another useful data source.

Distances have been estimated using distribution data, which suggest that bursters occur either within about 300 light-years of Earth (well within the local thickness of the galactic disk), or within 150,000-300,000 light-years, or out at billions of light-years. The second range of numbers is beyond all the visible stars of the Galaxy, including the globular clusters which extend out to 40,000 light-years, and is in the neighborhood of the Magellanic Clouds and beyond the halo of dark matter assumed to control the gravitational dynamics of our Galaxy. These estimates suggest where the bursters aren't, but for a better idea of where they are, we will have to wait till spectral data are available.

Redshifts provide a direct indication of distance, but their calculation requires accurate spectra. BATSE records energy levels, which are raw data whose distribution, duration and strength can be interpreted directly and hence have been studied right from the first availability of the data. BATSE also records spectra, that is, the full complement of wavelengths making up the electromagnetic radiation, but transforming that data into something interpretable requires calculation. Theoretical background for some of the calculations is still being worked out, and the programming to calculate gamma ray spectra has only recently been developed, so that very few are available for study, and those that are available come from bright bursters. It is possible that statistical studies of many more observations gathered over the next few years may allow an overall red-shift to be estimated.

What few spectral data have been acquired so far speak against the idea that photons from the bursters have traveled very far. No evidence of redshifts has been found up till now, which is completely implausible for radiation traveling billions of years. Cyclotron resonance, a somewhat delicate pattern caused by magnetic fields at the gamma ray source, is unlikely to be visible in energy that has traveled across the whole Universe, and the positron annihilation peak would no longer appear at 511 keV (due to redshift). Yet both Russian and Japanese satellites, as well as balloon studies, have detected these two patterns. BATSE data have not yet confirmed them, but spectral analysis has only just started, and it is too early to say that these patterns won't be found.

What has been found in the BATSE data are spectral patterns that break at relatively low energies (Fig. 2),

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which occurs in high energy reactions. A reaction with sufficient energy close to home could be something relatively small, like an antimatter explosion limited to a few tons of mass, but an event at the edge of the Universe would have to be so energetic as to be physically impossible. The energy breaks in BATSE spectra are sufficiently low that they must come from very high energy reactions. So much energy is reaching the instrument that only a close source, within about 3,000 light-years of Earth, is plausible.

Recently, in January 1993, the most powerful gamma ray burst ever detected was reported from BATSE. Unfortunately, this has made the theorists' job even more difficult. This burst was so powerful that no known event out at cosmological distances could supply enough energy, *unless* the radiation were channeled into jets, some of which just happened to be pointed at us. Some theorists therefore now favor the hypothesis that the bursts are beamed jets, since this is the only possible explanation if one insists on placing the causal cataclysms at the edge of the Universe. However, only some of the jets point toward us, so there must be many more of them to account for the number of jets visible to us. Given the types of collisions required (after all, black holes are rare, and colliding black holes are even rarer), it is

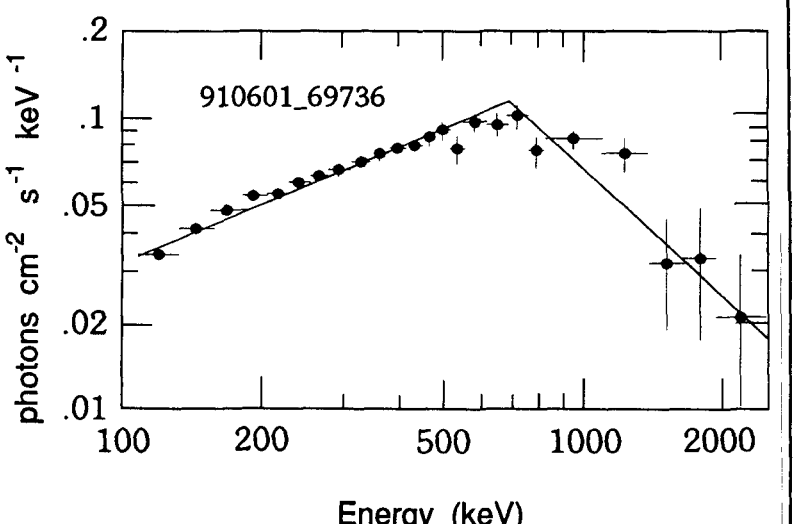

Figure 2: BATSE spectrum of burster #910601_69736, showing attenuation of gamma rays more energetic than approximately 700 keV. (Redrawn from Shaefer et al., 1992)

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stretching probability, even given the vastness of the Universe, to assume that many neutron star and black hole collisions are occurring every day. It seems to be more realistic to assume that the explosions are happening nearby.

Gamma ray burster data require a compact source, and they suggest a close source, whose emissions are limited to the highest energies of electromagnetic radiation, and which has some kind of magnetic containment. But instead of working on testing the obvious hypothesis of alien engines (perhaps because the probability of getting funding is considerably lower than the likelihood that aliens exist), scientists have concentrated on natural explanations.

Neutron Star Theories

Astronomers have not really contemplated the close-to-home hypothesis, because no known astronomical phenomenon in our neighborhood could generate gamma ray bursts without other associated radiation. Instead many astronomers have concentrated on modifying theories involving neutron stars so that they fit the observed distribution.

The true diehards have modified the local neutron star hypothesis to fit an isotropic distribution. Instead of neutron stars within the Galaxy, they postulate high-speed neutron stars moving fast enough to escape galactic gravitation. By the time the stars reach 150,000 or more light-years from the main galactic disk, which is still considered "local" in cosmological terms, they are assumed to have aged enough to change from pulsars to gamma ray bursters.

The local neutron star theory requires many assumptions tailored to fit the theory. Pulsars have not been observed as strong gamma ray sources, and adherents to this theory assume that exceptionally strong magnetic fields on some stars turn them into bursters. The theory requires a very unusual initial population of stars to form the unusual high velocity pulsars, a population unlike any currently seen, and whose possible historical existence is not supported by the distribution of elements in the Galaxy. Also, since our Galaxy is not unique, similar halos of pulsars/bursters should be seen around other galaxies, but they are not.

A galactic halo of neutron stars has enough evidence against it that many astrophysicists lean toward the cosmological hypothesis, where the bursters come from billions of light-years away. Mere infalling matter cannot generate enough energy to create a gamma ray burst detectable from that far, so the hypothesis shifts to collisions of whole neutron stars, or of neutron stars and black holes, or of "strange" stars composed of quarks. These can indeed generate the energy required to make a burst visible to us, (though not enough to explain the most energetic bursters, discussed above). And, assuming the bursters are *not* beamed, it is possible that there would be enough such events, given the vastness of the Universe, to account for the observed frequency of about one thousand

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bursters per year.

There are, however, problems with the cosmological collisions idea. The first is the same problem of location, transposed to a different key. If neutron stars, or black holes, or the like are involved, the bursters ought to occur more commonly in the neighborhood of clusters or superclusters of galaxies. They don't appear to, though additional data may indicate some clustering that is not yet evident.

Lack of Associated Radiation

Another objection to the collision hypothesis is the lack of any other radiation associated with the gamma ray bursters. Colliding stars or black holes would have to release 1%, possibly more, of their nuclear energy as pure gamma rays. This is unlikely in any case. Nor have theorists arrived at a consensus concerning the observable characteristics of such a cataclysm, that is, no one knows what it would look like if it happened. In addition, where is the other 99% of the energy? We should also be seeing UV bursters, and even visible light bursters, sometimes all coming from the same event. But we don't.

The astrophysical theoretician Paczynski has pointed out that relatively little radiation, including gamma radiation, might escape from neutron star or black hole collisions, since their gravity is so strong and their substance so dense. In particular, this much energy would involve the release of some baryons, which are opaque to electromagnetic energy. To overcome this problem, Paczynski suggests that bursters occur from collisions between "strange" quark stars, which would theoretically be expected to release gamma rays.

Rees and Mészáros advance another explanation to get around baryon opacity. Since the baryons trap the radiation, they suggest it is converted to kinetic energy, endowing the particles exploding from the collision with speeds approaching that of light. When these hit the interstellar medium, the kinetic energy is reconverted to high-energy photons, specifically gamma rays. The authors feel this explains not only the lack of associated radiation, but also the time profiles of bursts, which are usually too slow, extended, and varied to fit a neutron star collision. It is, however, hard to see why absolutely all the particles from a collision should accelerate to relativistic speeds; and if not all do, there should be some other detectable radiation.

A few times bursters have lasted long enough to allow other instruments to be focused on them. On one occasion a multi-day burster led to the identification of a faint source at optical and UV wavelengths, showing what appears to be a gamma-ray nova. Perhaps associated radiation would be found in other bursters if we could just get a long enough look at them. But the very oddity of this particular source suggests that the nature of the others would be quite different.

Weak Source Deficit

Yet another difficulty is that gamma rays interact with infrared photons in

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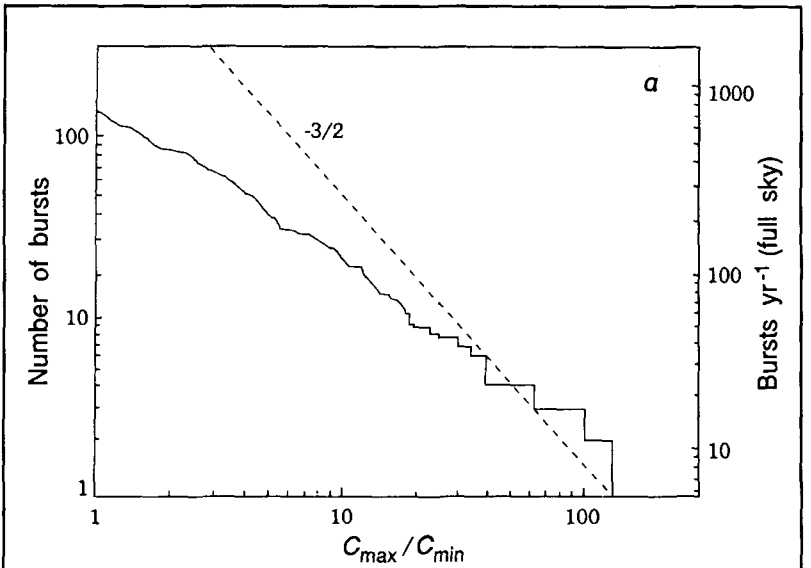

Figure 3: Number versus strength of gamma ray bursts. Strong bursters toward 100 on the x-axis, weak toward 1. Dashed line shows expected numbers of bursts for any given strength in a perfectly spherical distribution, and the number of strong sources somewhat too high (though their sample size is small, making conclusions about sources suspect). (Redrawn from Meegan et al., 1992)

the intergalactic medium, losing their energy. We ought, logically, to be seeing a large number of very weak sources, if they're coming all the way from the edge of the Universe, because so many would have been attenuated on the way. But in fact, the opposite pattern occurs. There is a deficit of weak sources, not an excess (Fig. 3).

The weak source deficit has another implication as well. It means we must not be at the center of burster distribution. To visualize this, imagine yourself as the guest of honor at the world's most enormous fireworks display. All around you, as far as the eye can see, fireworks are being set off. Right out to the horizon, you can see progressively fainter and fainter bursts. If, on the other hand, you approached one inner edge of this massive ring of fireworks, you'd have more very bright sources near you, and you wouldn't be able to see the weakest sources furthest away across the circle. This distribution is what BATSE has seen so far: a slight excess

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of strong sources, and a deficit of weak sources. If we're not at the center of the bursts, then they can't be happening out at the edge of the Universe, because we are at the apparent center of everything happening that far away. An alternate explanation could be that different types of sources generate gamma bursts, and that some types are not evenly distributed.

Time Profiles

Bursts share the characteristic of brevity, as their name implies, usually lasting from one to a few hundred seconds. Everything else about their timing varies (Fig. 4), which supports the idea of different causes generating the bursts. Variables include: the initial phase when they build up intensity, known as rise time; the peak energy; the number of peaks; their duration; and the duration of the whole burst.

The duration of rise time, typically as long as a few seconds, is yet another problem for the colliding neutron star hypothesis. The energy release from such a collision would be over in a few milliseconds and would have a much faster rise time. The energy structure of the whole burst, with various levels of energy arriving at various times, is also too broad for what is expected in such a collision.

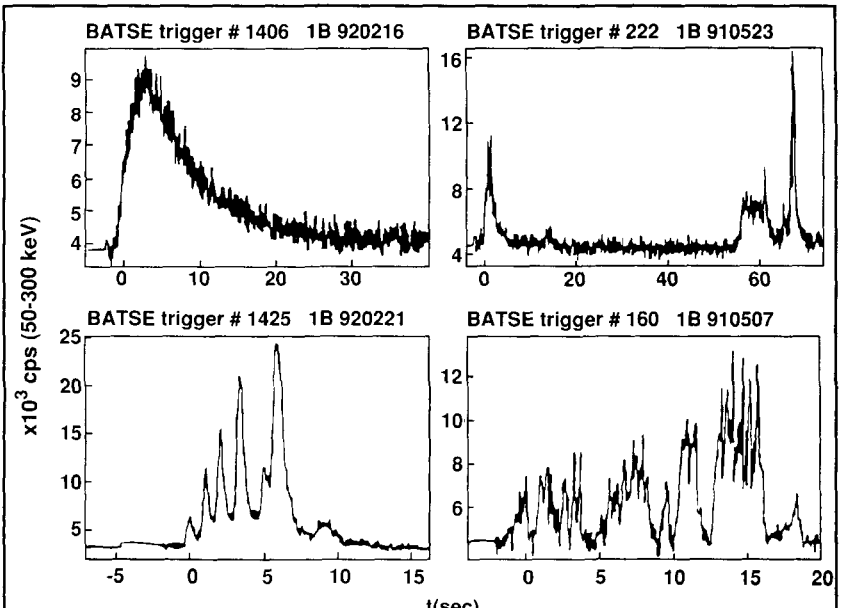
BATSE trigger # 1406 1B 920216
BATSE trigger # 222 1B 910523
BATSE trigger # 1425 1B 920221
BATSE trigger # 160 1B 910507
x10^3 cps (50-300 keV)
t(sec)

Figure 4: Time profiles of gamma ray bursters, from very simple to very complex burst patterns. (Redrawn from Fishman, 1993) (BATSE identifying numbers above each graph.)

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Paczynski suggests that possibly the collision results in the brief existence of an infalling accretion disk that accounts for the longer lifetime of gamma bursts, though still not for their "long" rise times.

OTHER POSSIBILITIES

So far we know that gamma ray bursts are found throughout the sky, must come from very compact objects, and don't appear to have any other associated radiation. We also know of no natural process that might have this set of characteristics. Prevailing theories that attempt to press the bursters into a natural mold seem to require as many favorable assumptions as a government budget.

What else could we consider? Could we be seeing hapless chunks of matter, or antimatter, bumping into cosmic strings? Because gamma rays are generated in strong fields, the potentially superconducting ends of the strings would have to be involved, according to Paczynski. However, cosmic strings pack so much energy in such a small space that all the energy would be released in a millisecond, according to theory, and the burster time profiles do not fit well. Still, further analysis of bursters from the perspective of string theory may bring interesting things to light.

A local phenomenon that forms a spherical shell around us is the Oort cloud of comets, but the only source both small enough and energetic enough to generate the observed bursters at that distance would be antimatter annihilation. Astrophysicists are very reluctant to imagine free-flying chunks of antimatter so close to home, especially since none has ever been seen in the inner Solar System.

However, an even stranger idea may fit the facts at least as well as the natural explanations. At least some of the gamma ray bursters are local, and are due to antimatter annihilation, but are not free-flying. This antimatter is carefully contained in magnetic fields aboard starships accelerating for interstellar journeys. The ships may be accelerating to superlight speeds, or they may be the slow-moving barges of the fleet, ferrying tools or medicines or foods at sublight speeds to young colonies.

Just as cargo planes and barges use different fuel, not all the spaceships may burn exactly the same fuel in exactly the same way, and the rate at which they burn may depend on the cargo, accounting for different time profiles. They might use positrons and electrons, protons and antiprotons, hydrogen and anti-hydrogen, or maybe something even more exotic. Since these are not accidental chunks of antimatter, it is not surprising that similar chunks haven't appeared in our Solar System. The number of bursts accounted for by this "strange" hypothesis could be anywhere from few to many. Who knows, maybe this alien civilization has just started interstellar colonization and can only afford a few flights a year. Whether it is many or few, alien spaceships are potentially distributed widely in our local space, would account for the lack of other associated radiation, and would provide a plausible source of compact, high energy events not seen

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Table 1. Gamma ray burster characteristics supportive and not supportive of the alien technology hypothesis

pro:	▸no other associated radiation, ▸compact source, local source?, ▸controlled burns (slow rise times, varying time profiles), ▸cyclotronic resonance?, ▸511 keV spectra
con:	▸no repeaters, ▸insufficient time profile similarity?
either:	▸isotropic distribution, ▸weak source deficit

within our Solar System. (Table 1).

It is worth noting that theorists suggest that bursters from the edge of space may be subject to gravitational lensing, and that the arrival of identical bursts separated in time would be proof of a distant origin. However, an equally good reason for identical bursts from the same place is that a ship has departed from the same port. If identical bursts are ever recorded, *either* of these two hypotheses could explain them equally well. A similar problem could arise in the calculation of overall red-shift, mentioned earlier. If alien ships account for only a few bursters, they could be lost in the data. Pooling data from different events should only be done when they are known to come from the same source, though then, of course, if their source is known, the need to pool the data disappears.

The major problem with this idea of alien gamma ray ships, is that one would expect the aliens to have ports, and therefore one would expect bursters to be concentrated there. The isotropic distribution of the bursters is a problem yet again. One would also expect similarity in some of the time profiles, though if alien ships account for only a few bursters, it may take time for similarities to become evident. In this connection it would be helpful if time profiles, and spectra when we get them, were mapped on to the distribution, so that possible local areas of similarity were evident.

Another possible problem is that repeated bursts have never been observed. The aliens may require only one massive burst for their purposes, but logically it would seem that a series of bursts would allow for more

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controlled acceleration and a smoother ride. But who knows, they may be speed demons with the ability to control inertial effects; or jumps to hyperspace may not work like that . . . .

One question, initially raised by Fermi when the presence of alien civilizations was being seriously considered, is "Why haven't they visited?" I can think of several reasons. One is that space is too vast for the probability of bumping into Earth to be good. However, if the bursters all around us are ships within 300 light-years, that is not a good answer. Another possibility is that Earth is a backwater. After all, Okiwi Bay in New Zealand may be an extraordinarily beautiful place, and not all that far away, but very few people have ever visited it, or even have a map detailed enough to find it. And finally, another answer may be, "They have visited, we just don't admit it." Though almost all UFO sightings have natural explanations, there are a few that cannot be explained away.

The wonderful thing about mysteries is the possibility they give us of seeing new wonders. Gamma ray bursters are sure to show us worlds undreamed of—and some of them may even be populated.

Reports have appeared on Internet newsgroups about a new property noticed in bursters: time dilation. Theoretically, an object at the edge of the Universe is receding from us so fast that it is moving at a significant fraction of the speed of light. At such speeds, time slows down, so light from such an object is visible slightly longer than it would be were the object moving slowly with respect to us. The lengthened time of visibility is called time dilation, and has not been observed before in incredibly distant quasars or galaxies because they shine continuously, and leave no clue as to whether their time is different from ours. Averaging the duration of a large set of bursts shows that dimmer ones tend to last slightly longer than the forty or so brightest ones. Assuming all bursts are generated by a similar process, and therefore that some bursts are dim only because they are distant, then the longer duration of dim bursts is evidence of time dilation. That, in turn, means bursters are located at the edge of the Universe.

The biggest problem with ascribing time dilation to bursters is that without any knowledge of what causes them, it seems risky to use brightness as an indicator of distance, especially in the absence of the enormous redshift a time-dilated object should have. It also seems risky to rely on averages in a set of objects that *may* be wildly different from each other, in particular because many do have very different time profiles.

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About the Author

Mia Molvray is currently an Assistant Professor in Biology at Loyola University, and also holds a degree in naturopathic medicine from the Deutsche Heilpraktikerfachschule. She has been active in her field for almost two decades, and has published numerous scientific articles. She has a strong nonspecialist's interest in astronomy and astrophysics. This interest is all the stronger because she has been a Registered Alien for part of her life. She is a native Australian, from a family that spoke Russian at home, and came over to the US on a boat. Since she and her neighbors all considered each other strange (it should be noted that this was, after all, Cambridge, Massachusetts), she is both prepared and eager to meet other aliens in the Universe. ■

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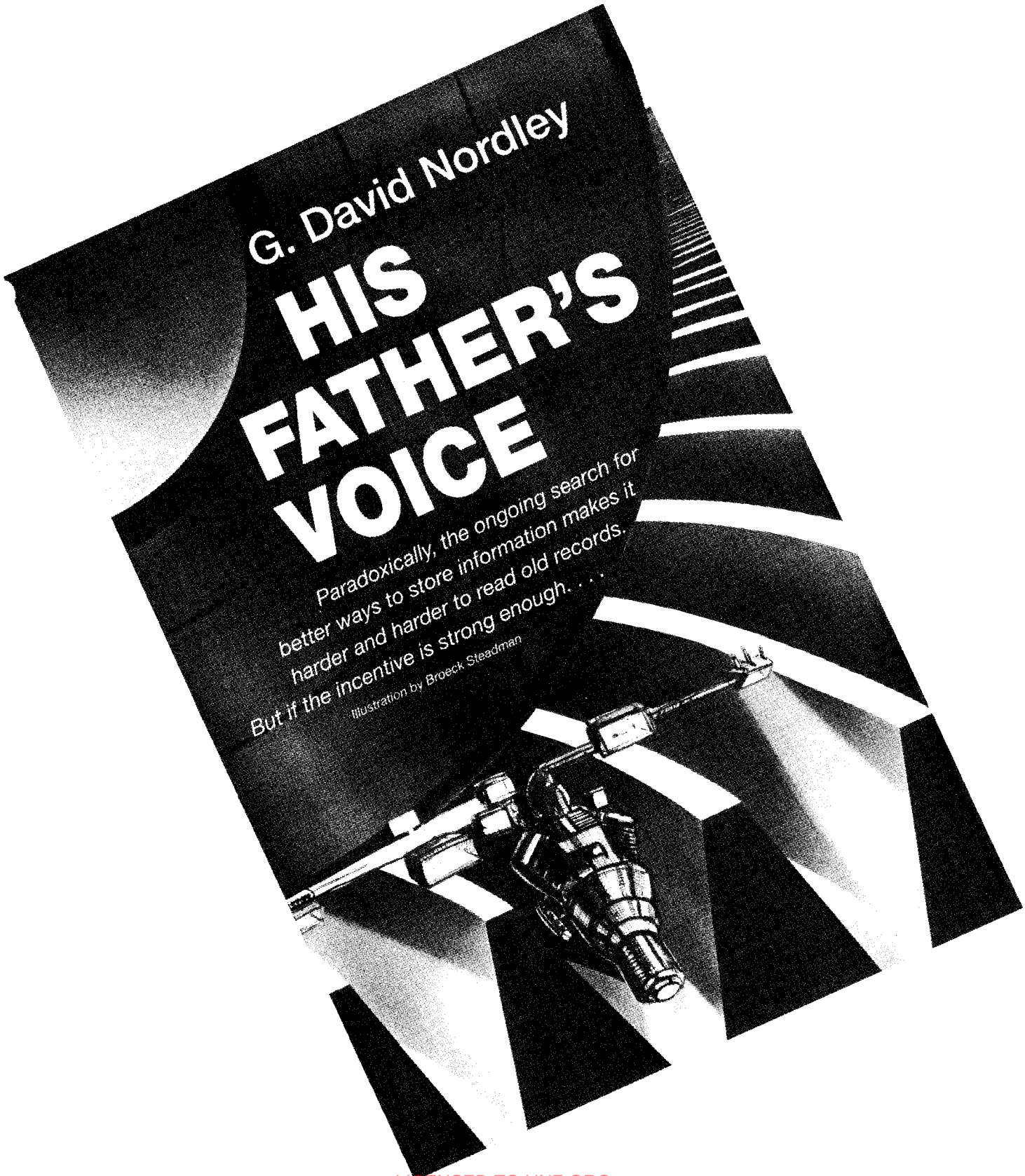
G. David Nordley
HIS FATHER'S VOICE
Paradoxically, the ongoing search for better ways to store information makes it harder and harder to read old records. But if the incentive is strong enough. . . .
Illustration by Broeck Steadman

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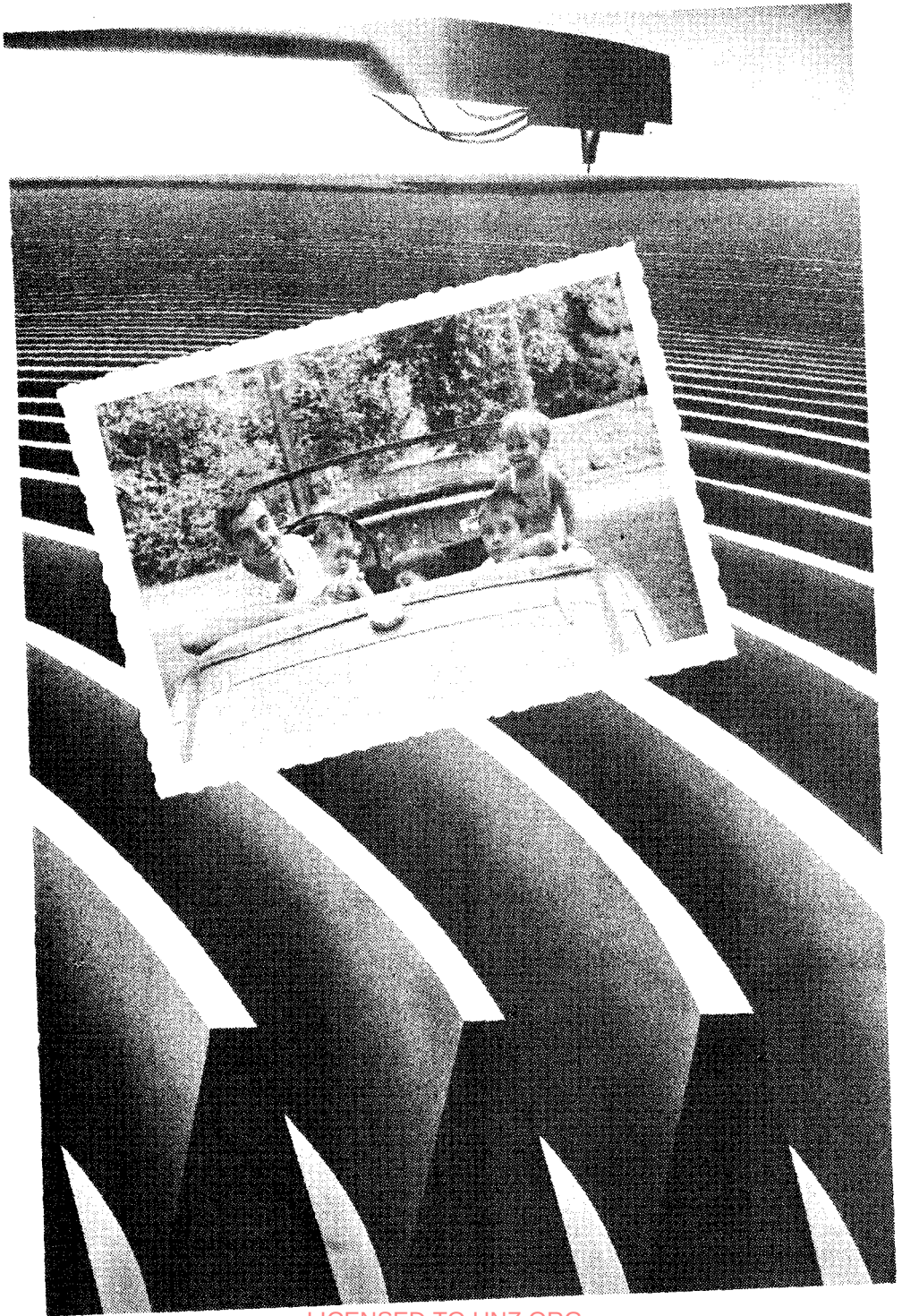

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Scott caught himself staring at the bare wood and web-cluttered beams of his late aunt's attic instead of packing, but he found it hard to concentrate. Ten days ago, Scott hadn't even known who his biological parents were. Now, his search for his heritage had led to a dusty cardboard box in this dusty attic, filled with faded and broken moments of the long dead hopes of a father and mother he'd never known. Carlo Valdez had been a poor man with a little talent who had tried so hard to be more than a cog in the universal machine, and Theresa Rodriguez a plain girl who had once upon a time seen the light of his father's soul and been momentarily blinded.

Theresa, it turned out, had died years ago, but her sister Maria had lived in this house they shared, increasingly frail, saving everything for "someone, someday, to make amends." Scott's arrival seemed to have completed something for her; he'd known her only a week, but in hours of talk, they'd begun to be friends.

Now Aunt Maria was gone too, her house filled with strangers going through things trying to decide who would get what. Some were so closely related to him that he had the uncanny feeling of looking in a mirror when he talked to them.

Thank goodness it was a loving family; the arguments were all of the "here, you take this, she would have wanted you to have it,"—"No, you take it, it meant so much to you. . . ." variety. Then everyone had been too kind to even speculate that Scott's surprise appearance might have hastened Aunt Maria's heart attack.

The pictures in the album weren't faded, though some of them were black and white. They'd been treated well and, except for the quaint clothes and old cars, looked like they'd just come back from the photo lab. Some pictures were of the people downstairs in their younger days, some of strangers.

But a couple of them included a thin girl with long straight brown hair, thick glasses and buck teeth in an artfully sophisticated pose: his biological mother, Theresa Rodriguez. The house was full of her, too, but as an older, more accomplished woman, in whose eyes and face the world weariness was not affected. There was little of her counterculture years here, a decade-long flight from reality that, Aunt Maria said, really ended only when they heard of Carlo's death. Scott had two boxes full of Theresa Rodriguez: full of photos, clippings, school papers, and other things that kind people, trying to make up for what they'd done forty years ago, insisted he take.

Also, there was one precious picture, not one of the best, but good enough, of his father in an apron in front of a barber shop. He could see himself in his father; short but wide-shouldered and deep-chested. The same pattern of baldness, offset by a neat, well-trimmed moustache. If Carlo Valdez had been nearsighted like his son, he hadn't worn glasses; or hadn't been able to afford them. If so, Scott thought, that might explain some of his father's people problems.

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Scott understood all about people problems. The person who had come up with the concept of the "alpha male" would probably have given Scott an "upsilon" or "phi." He'd been fourteen by the time the school had discovered he was mildly near-sighted; too late for all the unrecognized acquaintances, miscopied assignments, and athletic failures.

With his build, Scott should have been a football player, but he was, as it worked out, an untalented but adequate and diligently informed keyboard musician who supplemented his "maintenance engineer's" income by fixing electronic and acoustic instruments, playing at weddings, and teaching. His one stroke of luck, a few years back now, had been to help compose and play the keyboard on the pop hit, "Rather be Blue," that had paid the mortgage and still produced a few hundred a year in royalties. But people in the business had got to know him, shunned him, and he'd had to fall back on janitorial jobs to support himself.

Carlo Valdez had been a barber to make ends meet. But the man had been a singer in his heart and in his spare time; a basso in the Tri-city Lyric Theater and chorus for years, who had even changed the spelling of his first name to sound more Italian.

Then, at the age of fifty-four, with no savings to speak of, after years of romantic failures painfully documented in the bundle of letters, Carlo had made love with the stage-struck Theresa. It happened, the letters revealed, the night after his one and only performance as Don Giovanni as a last minute substitute for the Lyric Theater. A homely, artsy-craftsy girl throwing caution to the wind and an over-the-hill want-to-be had tried, for one night, to be real people. In 1964, the pregnancy had been a major scandal.

"People were so stupid and cruel, back then," one of his new cousins had said. "Theresa really loved him. He only lived three blocks away, and they'd talk when she came home from school. He would have married her, but your grandfather wouldn't have any part of that. So he left town, she left town, and you went up for adoption. She found Carlo years later, when she was on her own. She was a secretary, you know, worked for Peabody and Cramer for thirty years."

And a street and commune hippie for ten years before that, but only Maria had told him that. Scott had just nodded. "Yes, she found him. They wrote after that; the letters were in the box."

"Theresa," the cousin added, "got that box in the attic after he died; it arrived UPS from his boarding house saying it was all there was left and that Carlo had wanted her to have it. Then she moved in with Maria, and the box came with her. They looked for you, did you know? If you'd only been a few years earlier—"

"I didn't know," he'd told them. "I didn't know."

He'd lost his concentration again. He looked down from the rafters to the cardboard box. Dust. A photo album. Old letters. Programs from various productions Carlo had been in. Discharge papers—Carlo had been in

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World War II. Some vinyl phonograph disks, heat warped, cracked, in cardboard dust jackets. Unplayable. Pinza, Callas, Tucker, Tebaldi and what was this? Tri-city Lyric Theater! Excerpts from *The Student Prince, The Mikado, The Merry Widow,* and *Don Giovanni. Don Giovanni?* It had been *that* live performance; Carlo was listed in the title role. Why had they recorded that one? Was it the only night they'd had first-rate recording equipment? Or was it the best?

Impatient with excitement, Scott tried to pull the record from the dust jacket. But it was too warped to slide out easily, and before he thought to simply cut the dust jacket, it broke completely in two under the stress of his pull. He extracted the pieces and looked at the simple inexpensive label.

Scott groaned aloud. Damn! Was there some kind of curse running through his blood that decreed that his kind would get to touch the goal of their dreams once, then have it snatched away? Scott wanted to hit something, slam his hand into it and feel pain. But that would make too much noise, and then he'd have to explain and deal with the sympathy.

He took a deep breath instead and focused his attention on the fine grooves of the broken record; the music, his father's voice, were still there if he could think of some way to repair a record as broken and warped as the artist's life. He wrapped the pieces in an old newspaper so they wouldn't get further scratched, and fitted them gently, reverently, back into the jacket.

There must be something someone could do about that, he thought. Scott's inheritance, the one good thing in his father's life. Aunt Maria said Theresa had listened to that record over and over in her last month, dreaming of what might have been as her cancer consumed her drug-numbed body. Theresa had hung on until the turn of the century, but had not woken up on January first, 2002.

Scott carefully packed everything in the fresh book-pack moving box he'd brought, taped it up, addressed it to himself, and carried it downstairs.

There were polite good-byes all around and then, stuffed with fajitas and tacos, mellow with a Corona, he let his rental car drive him to the airport.

He was still distracted and disconnected when Betty picked him up in their ancient Reliant and brought him home from San José Airport to their two-bedroom ranch house in a cheap part of Mountain View. It had been built well over half a century ago, more for tight-budgeted junior officers from the old Navy field than for software executives. But even with the mortgage paid, the taxes were almost more than they could afford. The neighborhood was poor, but relaxed; people who had bought recently were poor from making payments, long-term residents had always been poor. The streets were lined with old, dented, gas-engined pick-ups, and the air was multicultural with outdoor cooking from everywhere around the planet.

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Scott took his precious box into the garage through the rear door to his shop. There was, he realized, the same sense of neatness and order to his workbench as in his father's photo album and the other things in that old carboard box. Carlo Valdez had not had much, but as Scott's new relatives assured him, what he had was always in good order. So with his son.

Scott had taken two years of junior college physics, but didn't go on. He'd really been more interested in music. His adoptive father died drunk in a car wreck and he'd gone to work after school to help make ends meet. That had been the end of good grades. He got his AA and did band gigs.

In '95, the China War caught his reserve unit, and when he got back, Mom—she would always be Mom to him—had lost her job. He'd gone to work full time for the school then and played for money at night. When Mom passed, Betty, a simple woman from a good family whom he had thought of only as a friend on the job, had offered to help with the inheritance taxes in exchange for the spare room.

That had lasted two weeks, Scott remembered with a smile. A simple, determined woman, who'd seen something in him no one else had seen.

Staring at walls again, he reproached himself. Somehow, he would do something to make her right, something for Theresa and Carlo, something to close a wound half a century old. Back to work.

He spread paper towels on the workbench, opened the box, placed the broken halves of Don Giovanni gently on them, and stared. Somewhere, in the neat rows of boxes that lined the garage, was an old Girard turntable. He searched, found it, found connecting wires, found their old amp, used alligator clips to attach the speakers from the old boom box he had for companionship in the shop, and ran the ridges of his thumb under the stylus. Nothing.

Three hours later, he'd found the broken wire, soldered it, tested again and was rewarded by a hollow grating sound. Very good. Betty called him to go to bed.

After work the next day, he had disassembled, cleaned and lubed the turntable. Then he got it to play one of the unbroken records, after a fashion; it wowed as the needle went up and down the warped hills of the old disk. Nevertheless, progress.

Back to the recording of Don Giovanni. He blew the dust off and studied the broken edges again. With a dozen small clamps—you never have too many clamps, he thought—he managed to hold the edges back together. They fit. He got the Super Glue, carefully wet each edge and pressed them together, using large rubber bands around the clamp mounts to hold everything tight.

Two days later, he tried to play the record. But it broke again the first time the stylus hit the imperfect joint.

"What's the matter, hon?" Betty asked as he crawled into bed. She levered herself up on an arm and looked at him with that motherly concern that falls full on the husband in a

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childless family. She'd never made any pretense at beauty; too strong-featured, too pear-shaped. But she ate sensibly, did physical work all day, and exercised those muscles that didn't get what they needed that way. Her spare, big-boned figure wasn't stylish; but it was pretty good for a woman in her forties.

"It broke again."

"There's got to be someone who can fix it."

He stroked her gently with the back of his hand and she smiled.

"Yeah. But they're expensive."

"It means a lot to you. I'd rather put money into recovering your Dad's voice than another dinner out."

Scott laughed. "I'll ask around." Then he slid over to her and they began to make love. She was the only one he'd ever been with, and he was too grateful to be curious about others. She was heaven.

Afterward, they had the house turn the bedroom wall set on, and took a virtual trip over Pluto, courtesy of C-Span and NASA's latest probe. It had vast areas of rolling, washboard-like hills, blown up dramatically to ten times their real scale by hype-desperate NASA publicists. Various geologists tried, without too much success, to explain the hills, and Scott wondered what they really looked like. Betty giggled as his fingers mimicked their eye's virtual journey.

Scott's thoughts drifted from Pluto's valleys, to Clyde Tombaugh, and a meditation on persistence. When a chance to sing Don Giovanni had come along, his father, against all odds, had been ready for it. Never quit, Scott told himself. Never quit.

"Hmmm," the Audion engineer muttered for the third time as he examined the broken record. Then finally, "Yes, I think we can do that. We'll make rubber casts of each half, splice those together, and make a hard cast on that negative. That's going to lose a little fidelity, but not too much. Then we'll play it into the remastering system; you ought to get a pretty good CD out of it."

Scott nodded, then asked the hard question.

"How much?"

"Not that much, really. Less than ten thousand, I'd guess. Our business people do the estimating though, so you'll have to talk to them."

Scott nodded again. "Well, thanks for your help," he told the man with a confident sound in his voice, shook hands, and found his way out.

He didn't stop by the business office and he didn't let them see him cry.

Scott saw the garage sale on Calderon on his way home, and stopped because he was in the mood to buy something at a reasonable price. He noted some technical books on the card table next to a dirty laser-toaster. He shook his head; facing arrays of high-powered diode lasers, impossibly expensive twenty years ago, a top-of-the-line consumer product a decade ago, a piece of five-dollar junk now.

"Doesn't work," the heavyset dark haired woman in the lawn chair told him. He nodded.

There was more stuff in the back

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of the garage. Whoever had died had owned a microscope; a real one, not an educational toy. He took it out into the sunlight, pulled a hair from his beard and put it where a slide would go.

"Doesn't work," the woman rasped again. "The old jerk was always fooling around with scientific stuff that doesn't work. He should have read his horoscope more; now I tell you that works! Predicted he was going to have a bad day the day he died, it did."

But the microscope worked just fine. It was just a little old-fashioned; no built-in digital array, but the optics, the motion, the weight and steadiness spoke of a one-time top-of-the-line instrument.

"The little light doesn't go on," she added. That, he thought, would be the little light you used to backlight a sample slide. It probably needed a new bulb.

"How much?"

"Ten bucks."

He bit his lip. It might be worth a thousand. He ought to say something. Then he thought; she didn't give a damn about what the microscope meant, or she'd know what it was worth. The woman despised what it stood for. She had earned the fruits of her own carefully-nurtured ignorance, and he wouldn't do the world any favor by subsidizing that worldview. So he rationalized.

He looked at the hair again, and accidentally got his finger in the image and saw the loops and ridges as if they were the hills and valleys of another world, like those strange, periodically folded mountain ranges on Pluto.

He could sell the microscope for a tenth of what it would cost to recover his father's performance of Don Giovanni.

He gave the woman the ten bucks, his hands slippery with fear that she would change her mind and ask more. He only had eleven in his wallet.

"You can fix junk?" she asked as he handed it to her. "Take the toaster too. For you, one buck."

He shrugged. Spending habits: eleven bucks a day was three hundred thirty a month. Three years of that would recover the record. He smiled, gave her the buck, and took the toaster. He might indeed be able to fix it cheaply—but there were already many things that needed to be fixed in that garage.

Betty was waiting for him when he got home.

"Bad news. I can tell; you went shopping." She smiled.

"Bad news," he admitted. "Ten grand. They want ten grand."

"Your dad's important to you. We gotta know where we come from." She put her arm around him and squeezed. "Hon, we've got plenty of money in the house."

"We promised ourselves we wouldn't do that." The royalties and the dividends of what was left after they paid off the house were enough to eat on if they lost their jobs in another cutback cycle, if they ate ramen. Society had almost taken the house from him once for taxes—and the idea of giving the title to someone

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else, of giving the crooks, graspers, and cheats out there a chance at him, even though it made good financial sense, made him shiver. The house was what he had left of Mom's life, all her long hours at low pay, all her scrimping and discipline. He would not risk it. Mom, Carlo, Theresa, he vowed, someday I'm going to do something to make you all proud of me, something that makes it all meaningful. Something to make dad sing.

"Hon," Betty interrupted his thoughts, "we can't take it with us. You're obsessed with this; every night, every day we're not at work, you're in that workshop and we're not getting any younger." She pressed her body against him, and murmured, throatily. "Let's make some hay while the Sun shines. Go for it."

It lifted him out of his gloom a bit. "Hey, we gotta lot of years left, darling. We'll start saving more. Besides, maybe I can make some money off this junk I bought."

"OK, hon. Whatever you think best. I love you."

He answered with the distracted kiss of a man running after a dream and running out of breath as it got further and further away. Perhaps some things were not meant to be.

The day before the school's annual swap meet, Scott took the microscope and the now-working laser toaster out of their boxes for a last-minute polishing. The microscope tempted him again, reminding him of the days when he thought he might have a professional career ahead of him. A job in industry, or maybe even a professorship at some idyllic liberal arts college in a small midwestern town, far from want and tension; complete with fresh air, trees, and seasons.

The drawers of the plastic organizer that held his nuts and bolts had thin plastic dividers that he thought might make good sample slides. He pulled one out, frowning and shrugging his shoulders as some number eights mixed with some number sixes.

The now-working light could illuminate samples from above and below. The instrument worked perfectly, and he went on a microscopic odyssey, exploring nails, paint brush bristles, sawdust, bare wire ends and numerous other small objects.

Thinking back to the Pluto video, he took another look at the planet of his fingertip, and journeyed over its ridges. Then he remembered the phonograph needle over that same fingertip. He reached for half of his father's record, stored on one of the neatly labeled "open projects" shelves over the workbench, blew the dust off of it, and placed it in the focal plane.

The grooves wavered from side to side; he thought of flying along those grooves; he'd be jerked from side to side and get airsick. That vibration, of course, was how these old records made sound. Now if he were flying along that groove, his radar altimeter would experience a doppler shift as the surface came in and out at him.

Could he build a little something to fly along those grooves? If it weren't in actual contact with the re-

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cord, it wouldn't break when it hit the broken edge. And it wouldn't wear out the record—those old disks would last just as long as the CD's.

"Scott?"

"Oh, hi, darling."

"I brought you some soup. What are you thinking about?"

"I was thinking about building a sort of laser needle for these old records, that wouldn't touch the records so it wouldn't matter if they were cracked or warped."

"Sounds expensive. I mean, it would have to be very precise, wouldn't it? And precise things cost a lot."

She had a point. He started thinking about the servos, tracking, doppler transducers . . . damn!

"You're right, I think. The way the Audion guys were going to do it would cost a lot less, I guess."

The realistic professional in him could conceive of ten thousand dollars as being less. The boy reached out to the father he'd never known, and his hand closed on air. He couldn't give up, not now, not so close.

"Betty, I'm going to keep the microscope. If it's worth a grand now, it will be worth a grand next year. And by next year, maybe I'll think of something else."

"Sure, hon. Drink your soup."

But the next year was little different. He tried to make a tracking system, but it wouldn't stay on the groove. The stuff he needed to fix that was too expensive.

His latest idea was to guide the laser with a stiff Teflon fiber to track the groove, using a resistive diaphragm and servo loop instead of physical force to guide it. But there was an interaction mode between the fiber and the servo control that caused it to hunt its way out of the groove.

He'd been trying a software damper when Betty came to the shop.

"Hon, they're releasing the Persephone encounter tapes tonight. Want to quit and watch?"

NASA had found a four-hundred-kilometer iceball far out of the ecliptic for the Pluto probe to pass by. Some newspeople were calling it the tenth planet, causing a lot of astronomers to smile through clenched teeth. But it was probably the biggest event left in the saga of robot space exploration.

"Sure, why not? I give up. This isn't going to work either."

There. He'd admitted it. A broken idea depressed him even more than his broken record, and, uncharacteristically, he just left everything where it was. He turned as he left the shop, slapped the light switch off, said "Sorry, Dad," into the gloom, then followed Betty back to the house.

But instead of using the wall screen in the livingroom, she led him back to the bedroom.

"I know this sounds a little kinky, hon. But last time, well, it was kind of good."

Scott laughed. "Anything to please. We'll can it and play it back."

They did. They were making their fourth pass over Tombaugh ridge in deep afterglow when Betty suddenly gasped and her eyes snapped wide open. Then she laughed gently.

"Oh, Scott," she murmured, "did

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the probe actually fly down that valley, like this?" She took one of his fingers and used it to simulate the hypothesized probe trajectory in the folds of the bedding.

"No," he laughed, "they made a three-dimensional model of Persephone in their computer and just transformed the coordinates of the pixels so that it looks that way, as if we were in a spaceship traveling right down that groove. . . ."

She giggled as he was rendered speechless. Of course! He had lasers. He had a microscope. He had a turntable. A drill press to hold the microscope. He could track by hand, to prove the concept. He had his home computer and its optical floppy. As long as he had the *picture* of the groove, he didn't have to fly anything *physical* through it. His "needle" could be a purely software construct.

He threw his arms around his wife and kissed her a dozen times, then looked at her grinning, giggling face with the first hint of a suspicion. Exactly what *had* she been thinking while . . . ?

It was a rich, full organ of a basso voice, perhaps a little off key, perhaps with not enough breath left at the end. But it had an impressive volume, and with training, Carlo Valdez could have been good, very good.

It echoed through Scott's new house hidden on the wooded hill, a modest mansion as such things went, only thirteen rooms around a great, square Castillian courtyard, but it was unmortgaged. One wall was filled with old LP's; a collection purchased for peanuts before they became worth millions.

The programmers assured him that yes, Carlo sounded just like Carlo had sounded, but that disappointed them because they could have made it sound better than Carlo had sounded.

But Audion's new Research Consultant had politely told them where to go with that idea. If you could see me now, Dad, he thought.

"I should never have believed it. . . ." his father sang. ■

While I applaud attempts to think rigorously about the far future, it cannot be done by the simple extension of handy rules of thumb. Other species, particularly, have other thumbs.

Gregory Benford

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Probability One

UNPLANNED-FOR FLYING OBJECT

Edward M. Lerner

The extraterrestrial object soared silently around the curve of the expressway, spewing intense radiant energy. Powers uncontrollable by mere man kept the object hovering just above the horizon.

As a wave of red taillights flashed towards him, Don Shaw stepped firmly on his brakes. The crunch of metal and the tinkle of headlamps somewhere to the rear announced the presence of a driver with reflexes slower than his own.

In the intensely bright light, buildings and lampposts cast long, knife-edged shadows onto the road. Reflections from the glowing entity glinted off the chrome, paint, and glass of the river of cars before him. Heat from the distant orb struck at him through his windshield. An unseen convection current caught a weathered sheet of newspaper, lifting it over Don's car.

He glanced into the pickup truck stuck beside him. The yahoo behind the wheel squinted, gape-jawed, into the glare. The bill of his backwards baseball cap threw its shadow uselessly behind him. On his other side, a well-coiffed, well-dressed businesswoman tried in vain to ward off the light with a well-manicured hand.

Don pondered the other worldly object that floated so effortlessly before him. Some of the finest minds in the world had studied it closely. Indirect evidence suggested, he'd read, that the visitor was fusion powered. Federal authorities had tracked its course and extrapolated its appearance with great accuracy, even forecasting its arrival through the local media.

Their warnings had fallen upon deaf ears.

Trapped between exits, there was nowhere to go now but forward. Nowhere to head but straight towards the luminous apparition. He waited for those ahead of him to reach the same decision. They were slow to do so: in ten minutes, he crept forward by less than a mile.

Finally, Don could bear his entrapment no longer. He rolled down his window and stuck his head through the opening. Harmful actinic rays from the distant object struck at his unprotected face.

"Idiots!" he shrieked. "Imbeciles! Buy yourselves a pair of shades.

"The Sun is going to keep rising *every* morning." ■

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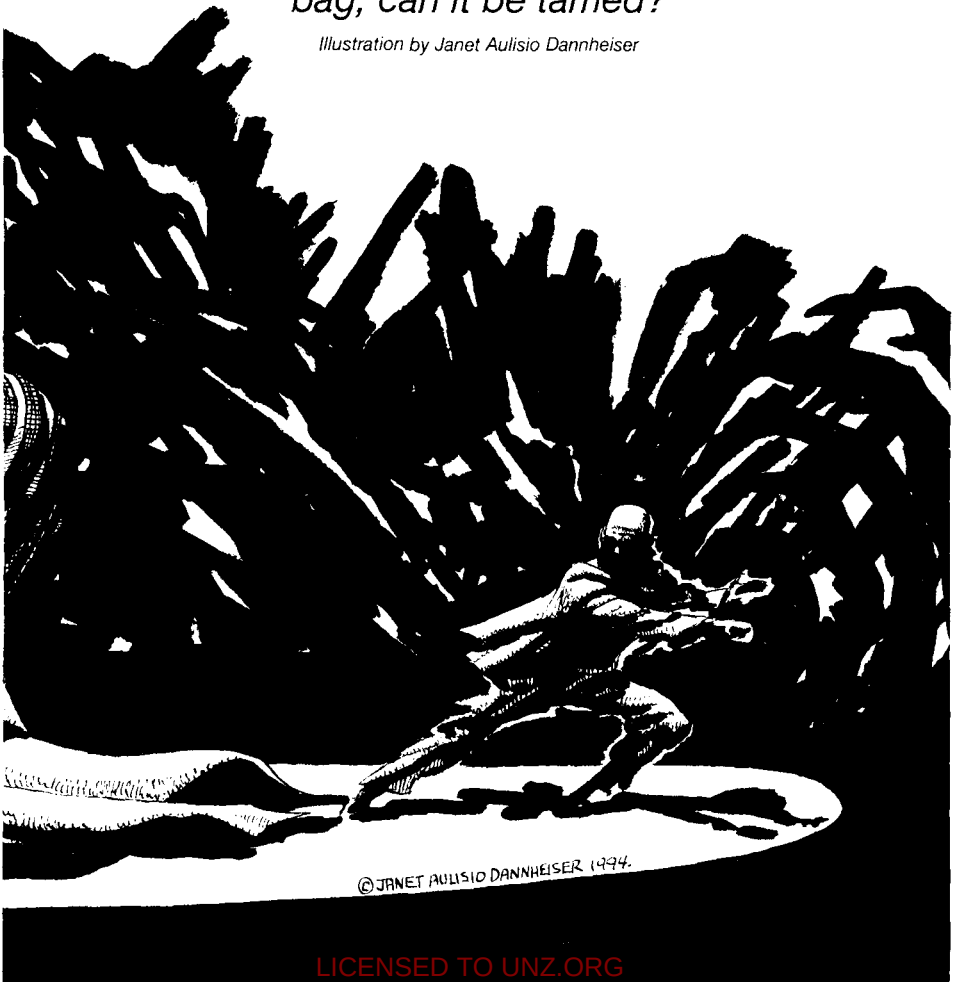
Hayford Peirce

MIDWIFE

If a cat can't be stuffed back into its bag, can it be tamed?

Illustration by Janet Aulisio Dannheiser



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. . . Bantry's time scanner, that miraculous gadget for viewing the past and whatever had happened there—that was what the cops needed in cases like this. . . .

. . . The scanner—the greatest invention in human history. . . .

. . . And with the greatest potential for good or evil. . . .

. . . Pretty soon we'll know which way it's going to go. . . .

. . . Good . . . ?

. . . Or evil . . . ?

These were the immediate, if rather disjointed and melodramatic, thoughts of Samuel Garraty Ferron on this August morning of 2074, as he blinked with outrage and disbelief at the page of the *Washington Clarion* that had just been printed by the office commcent. In repulsive color and sickening detail, it showed the bodies of a family of four visiting Norwegians who had literally been cut in half on the steps of Washington's John Paul Jones Memorial. The police speculated that the weapon was an illegally modified industrial laser wielded from a passing van. A random, totally gratuitous act of horror.

PAINLUSTER REVIVAL? screamed the paper's headline. The senior senator from New Mexico stared blankly a moment longer, then crumbled the page and tossed it in the recycling bin. "Painlusters?" he muttered aloud, his thoughts still scattered and fuzzy, for it was barely five o'clock in the morning and he had just arisen from a troubled night on the office cot. "It can't be. They're all *dead*." He took a cautious sip of steaming coffee, then a longer swallow. Hadn't he himself witnessed the execution of the last American painluster at Leavenworth Federal Prison nearly twenty years ago, back in '55 or '56? The seventeenth and concluding year of the Great Sweep, that was, the worldwide rat hunt that had exterminated the hundreds of thousands of organized sadists who had so inexplicably come to infect an entire planet.

"No!" Sam slammed his hand painfully against the top of his desk. Isolated, demented, dope-driven crazies, that was what the killers of these Norwegians had to be. Painlusters were forever dead and gone, thanks to the determination of people like himself—and to interrogation by perceptualization enhancement, the relatively minor scientific miracle that allowed an infallible determination of guilt or innocence.

If first you could get your hands on someone to interrogate.

That, of course, had always been the Achilles heel of perceptualization enhancement. What could the cops do with a random drive-by killing like this one with no apparent motive and no witnesses? Get a court order to haul in every one of the three million inhabitants of Greater Washington and question them one by one under PE?

Sam snorted in angry frustration. Of course you couldn't! But on the other hand, you couldn't let crime and violence and organized insanity spin out of hand again like they had back in the '20s and '30s. And in spite of PE, some of those horrors did seem to be returning, at least in the occa-

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sional cases of unspeakable violence like that directed at this poor Norwegian family.

Could the rising tide of inexplicable hatred of these last few months have anything to do with the Federation?

Sam stared bleakly out the window of his corner office in the Capitol. The first rosy traces of the new day were brightening the top of the Washington Monument; his thoughts drifted to the Federation.

Much of American sovereignty had already been surrendered to the bureaucrats in Geneva, along with its entire nuclear arsenal; what little sovereignty remained was now the issue before the Congress: would the United States Senate finally ratify the Constitution of the Federation, thereby in effect voting itself out of business for all but the most trivial local concerns?

So far the answer had been no—but only because of the filibuster that he and other like-minded senators had mounted to prevent the decision from coming to an actual vote. For three months now the Administration had tried every tactic short of actual hostage-taking to force the ratification to a vote; for three long months forty-one senators had blocked that move by non-stop oratory. Passions were running high across the country—and violence had been threatened by supporters of each side.

Was this incident a demented response to the final, tangible closing of the mystical American Frontier, and to the centuries-long sense of freedom from the dictates and strife of the corrupt Old World? Or was this overly glib explanation nothing but equally demented sociological psychobabble?

Perhaps, perhaps not. But the number of such incidents was undeniably growing, and had to be stopped.

Along with a number of other things, some of them of far more importance than the crime rate in Washington, D.C.

Sam sighed. Was he paranoid for sometimes thinking that all the burdens of the world, as well as all the hopes of humanity, rested upon his own tired shoulders alone?

Or was the word *megalomaniac?*

No matter. He set down his empty coffee mug and squinted at his wristphone's time display. He was due on the Senate floor in precisely forty-four minutes to put in his own three-hour stint of filibustering oratory. Yes, plenty of time. For there was, of course, one infallible way of stopping this latest outbreak of barbarism, a *genuine* technological miracle that by comparison made detection by perceptualization enhancement seem like the divination of chicken entrails.

If it could be introduced to the world without being suppressed by the Federation—*and* without getting its sponsors permanently axed as well.

Sam's lips tightened. It was time to find out what his infuriating ex-son-in-law was up to—and how much closer he was to getting all of their heads chopped off by the Federation.

Roderick Bantry, his face framed in Sam's deskphone, seemed as brisk

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and darkly handsome as ever in spite of the fact that it was not long before midnight Hawaii time. He ran a hand through thick, curly black hair while a slightly sour grin tugged at the corners of his mouth. "The eminent senior senator from New Mexico himself. What can I do for you, Senator, at this ungodly hour?"

"Hello, Roderick." On closer examination, Bantry's face had thinned, and there were noticeable worry lines around the eyes of the man who had been married to Sam's daughter for nearly four years. "Astronomers worked at night, I thought, so I took a chance that you'd still be up."

"I don't actually do as much around the observatories at night as the real astronomers do, but tonight you're lucky. And you're in Washington, are you, heroically manning the filibuster barricades?"

"I'll be on the floor at the stroke of six A.M."

"Will you be able to stop them?"

"I don't know. They need 60 votes for cloture; so far they've only been able to scrape up 59."

"Just one solitary senator needs to change his mind and it's all over for the good old U.S. of A.? Them's mighty slim margins, Senator."

"To keep the Federation from nosing through our affairs? I agree, Roderick. And it won't be me you see changing his mind."

"Glad to hear it. I . . . well," Bantry's mouth twisted and he appeared to look down at something off-screen. "Well, I don't imagine you called just to talk about your filibuster."

"No. Bruce tells me that he's been talking to you off and on for the last couple of years, that you've been very helpful to him." Bruce was Sam's fourteen-year-old son.

"I thought that was our little secret." Bantry's eyes flickered and he shifted uneasily in his chair. "Are you mad at . . . me?"

"I suppose not. He's old enough to make up his own mind on things like that. So you've been using your O-CLIP to run some of the programs he's written?"

"He already knows a thousand times more about computers and programming than I do. I'm glad to help him. Maybe someday he'll be helpful to me in return."

"Maybe. If there *is* a someday."

"That sounds ominous."

"These are ominous times. The Federation *really* wants us to ratify this Constitution of theirs. I've been getting phoned death threats from people in ski masks, both deskphone and wristphone. So have all the other senators on our side of the filibuster. And so have my family. I—"

"Your *family?* Including . . . Emily?"

"Emily, too. As well as Bruce and Marianna. They're all under FBI protection, but who knows what that means against crazies—or a worldwide government convinced that the ends justify the means."

Once again Bantry's gaze moved off-screen. "Sam, you *know* that with Emily it wasn't how things seemed. I—"

"I know, Roderick, or at least I know what you think things were like. But all that was four years ago. Right now I want to know if there's

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any evidence of the Federation, particularly the Office of Planetary Security, messing about with you and Linda the way—"

"Linda? My darling spouse who's already spent half the Nobel money in advance?" The bitterness in Bantry's voice was palpable. "I haven't seen the bitch in six weeks."

Sam briefly averted his own eyes. He had never liked the woman who had forced herself onto Roderick Bantry as his second wife, but it was painfully embarrassing to be confronted by such naked hatred.

"But she's all right as far as you know?"

"The bills are still coming in from Europe, so she must be all right. What *is* this, Sam?"

Sam sighed. Just how good at eavesdropping *was* the OPS? Right now, with every indiscreet word they uttered they might well be putting their necks on the line. But short of flying to Hawaii, he'd have to say *something* to Bantry. "Bruce tells me that he thinks you're about to go public."

"He does, does he?" Bantry's mouth tightened. "Is that what this call is about?"

"Yes. I think we're running out of time, Roderick. The Federation and the OPS have already got their hands on all the weapons of mass destruction throughout the world and are busy shutting down the plants that made them. You know what their charter is: to prevent war by any means necessary. No more Khyber Holocausts, Roderick, but by the same token, no more technologies of any kind that might ever be used to disturb the peaceful sleep of Federation bureaucrats."

"But that's *crazy*, Sam! The sca—the—this is the greatest preventive of war that's ever been invented! Give this to the OPS and no one would *ever* be able to prepare for war without the entire world knowing about it!"

"And no one could ever again commit a crime and get away with it. Yes, I know, Roderick. But I don't think the Federation is going to see it that way. At least not to the point of letting every local police force in the world have one to play around with. When you think about it, no matter how fancy their new Constitution may be, at bottom the Federation is composed of nothing but thousands and thousands of bureaucrats and politicians. And you know how much any politician or bureaucrat anywhere in the world likes the idea of having every one of his private little deals and secrets being absolutely open to the public eye."

"I *know* all this, Sam! Why do you think I've been hiding over here in Hawaii for the last four—"

Sam passed a weary hand across his face, then across the shiny scalp from which the last remaining wisps of white hair had finally disappeared. "Sorry, Roderick, I guess it's too early in the morning for me to be thinking clearly." Or, he groused to himself, maybe it's just that at sixty-six I'm finally getting old.

Stop letting your mind wander like this! "What I really mean to say is this: the Federation already has its fingers

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stuck in most of our domestic pies. And as soon as their Constitution is ratified—and it will be, Roderick, it will be—then they'll have their fingers in the rest of them. And that means that you personally can kiss your Nobel goodbye—you'll never have a chance in hell of introducing it. And I just happen to think, Roderick, that the only thing that is going to keep us from turning ourselves over to a worldwide dictatorship is the sca—that thing we've been talking about. So it comes down to this: *Just how close are you to introducing it?"*

It was, Sam knew, in some ways an utterly unfair question. Bantry had been more than ready to introduce it four years ago, almost since the moment of its inadvertent discovery at Emily's clinic on the shores of Eagle Nest Lake in northern New Mexico. There had, however, been . . . circumstances.

Sam still didn't have the faintest idea how the scanner worked, or why. All he really understood was that one night Roderick Bantry had sneaked into the tightly sealed computer room of his wife's clinic to surreptitiously—and in full defiance of federal law—use its superpowerful three-dimensional O-CLIP computer to construct a theoretical model of one of his subatomic hypotheses. Instead, he had unexpectedly created on the computer's monitor a two-dimensional, black-and-white snapshot of a scene that was identifiable as an image of the recent past.

Bantry at the time had been designing graviton readers for the physics department of the University of New Mexico at Santa Fe. Further investigation had shown that certain types of data taken from a graviton reader had to be input into an O-CLIP computer; in some inexplicable way this was the mechanism that created what the few people who knew of it had come to call the time scanner.

But three-dimensional O-CLIP computers had been deemed by the federal authorities too powerful to be let loose on the world. By secretly using Emily's O-CLIP to create his time scanner, Roderick had put himself and Sam's entire family at risk of federal prosecution.

To keep themselves out of jail, Sam had been forced to work a deal with Bantry: the astrophysicist would go to live somewhere far away; and Sam would do what he could to help him find a way of introducing the scanner to the world without putting all of them at risk, from either the federal authorities, or, even more ominously, the Federation's recently created Office of Planetary Security.

"Even the Federation isn't all-powerful," Sam had muttered to his wife, "at least not yet. Maybe they can suppress a college professor like Bantry, or even a United States Senator like yours truly. But they'll think twice about going after Harvard or Oxford or the Sorbonne or Apple-IBM. *If* we do it right. Somehow I'll have to fix it so that someone in that league shares the credit with Roderick—and the blame."

So far the bargain appeared to have worked. Even before Emily and Bantry had been formally divorced, Sam,

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as a member of the Science Appropriations Subcomittee, had come across an interesting item concerning the SETI Corporation.

Seticorp was a semi-public company partially funded by government appropriations to search for extraterrestrial signals; for thirty years now it had leased facilities from the University of Hawaii in the observatories on Mauna Kea, the gigantic volcano that comprised the so-called Big Island of Hawaii. Now, it seemed, Seticorp had applied to the government for a license for an O-CLIP computer. . . .

Three months later Seticorp had its new computer. It also had a new researcher on Mauna Kea, one with a solid pedigree in gravitons—and with officially approved access to the newly installed O-CLIP computer.

Now, four years later, Roderick Bantry nodded reluctantly. "Well, either Bruce is very observant, or I'm a stupid loudmouth. But he's absolutely right. We're going to give a demonstration at the annual astrophysicists meeting at the University of London next month. Prince Richard is a highly regarded astrophysicist, you recall, very distinguished in the field. We'll bring him in on center stage for some major public relations work. And we'll instantly hand out to the media several thousand complete plans for building your own handy-dandy scanner. I think our asses ought to be covered if we spread the credit around broadly enough and quickly enough. No one's going to try to suppress a member of the Royal family. Not even the Federation."

"You'd be safer still if you'd let Bonnie Prince Richard take all the credit for himself and you and your toothy smile discreetly faded from the picture. I say that seriously, Roderick."

Bantry flashed a brief, wintry smile, then tossed his hand with a flash of the old arrogance that Sam remembered so well. "No, Sam. I *want* that Nobel. Not only want it, I need it. I told you: Linda's already spent most of it in advance."

"Well, I guess I can't begrudge you that. But you're *certain* you've arranged things so that it's clear the discovery was made while using the O-CLIP in Hawaii? There's nothing at all that can trace it back to . . . to anywhere else?"

"Nothing at all," said Bantry with absolute certainty. He glanced over his shoulder, then leaned forward so that his face filled the entire screen. "Everyone here *knows* that I stumbled across it in the Keck Observatories entirely by accident. That accident and everything that follows from it has been minutely documented and recorded a million ways from Thursday. Sam, I was very, *very* careful."

"Mmmm." Sam pursed his lips. "Let us fervently hope so. Now let me change the subject a bit. You remember when I told you that if you could improve the range, we could use our . . . various facilities to keep an eye out to see if the Federation or anyone else was getting ready to come down our throats? *Did* you?"

"Did I improve the range? Yes. I still don't know much more about how the damn thing works than I did before, but the range was no problem

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at all. Once I got some of the other University people involved with it, we miniaturized a bunch of graviton readers and put them in geosynchronous orbit along with some of our regular equipment."

"What?" Sam was genuinely startled. "You've got this stuff up in *orbit?* Right *now?*"

Bantry grinned. "Sure, why not? The new readers only weigh a couple of pounds of apiece. Seticorp is always paying someone to put up tiny little payloads to help us with our search for little green men on the other side of the Galaxy. We just stuck some of our readers in with the other stuff. Nobody even knows about it except a handful of us here on Big Island."

"Geosynchronous orbit: doesn't that mean that with three or four of them you can blanket the entire *world?* That means that you could be sitting there on your volcano halfway around the world looking in on what I ate for breakfast this morning?"

"Or who you spent last Saturday night with in that hot-sheet motel down the river in Virginia," said Bantry with a savage laugh.

"Um," muttered Sam. "Well, we always knew that this was what it was going to come to. And why our throats are in imminent danger of being slit. All right, that's one of the two *did yous.* What about the other one?"

"What other one?" Bantry was frankly baffled.

"Did you use this expanded range to keep tabs on the Federation, particularly the security office? To see if they're planning any—"

"Oh." Bantry scowled and suddenly seemed less sure of himself. "Well, I *thought* about it. I thought about it for a long, long time. And what I decided was this: if I used the scanner to spy on them, and then the scanner was made public, eventually they'd use it to spy on me spying on *them,* if you see what I mean. Which would just give them another incentive for banning it altogether. For the same reason, I haven't used it to watch what goes on in the bedrooms of the rich and beautiful. I just don't want to give them *incentives."* He looked at Sam as if seeking absolution and his voice was little more than a whisper. "Sam, do you think I was right?"

Sam exhaled in noisy exasperation. "I don't know, Roderick," he said after a while. "I've got to admit that some of the same thoughts passed through my own mind every time I thought about that O-CLIP sitting right there next door to us in the clinic. Sometimes it's been awfully tempting to let Bruce loose on it to see what we could see. But—" he shrugged "—finally, I didn't. Like you, I decided it was just a little too dangerous." He exchanged a long, speculative look with Roderick Bantry. "I just hope we weren't wrong."

"Sorry, dear," said Sam ten days later. "I still can't tell you when I'll be home. This damn filibuster looks like it might actually go on for another couple of months."

"You mean *nobody* has changed her mind?" Marianna demanded incredulously. The sharply chiseled fea-

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tures of Sam's beautiful Brazilian-born wife looked out of his deskphone. Twenty years younger than Sam, she was sunny, totally extroverted, athletic—and absolutely uninterested in politics. "Then when *is* it going to end?"

"Probably when one of us drops dead—literally. All of us here are pretty stubborn cusses."

"Don't *say* that! There was another one of those awful men in a ski mask on my wristphone cursing and threatening us if you didn't change your vote. Sam, how *do* they activate the emergency override? I thought you could block your phone off to anyone you wanted to. And why can't they trace where they're calling from? And stop them! It must be against *some* law to threaten United States senators!"

Sam sighed. The FBI had quickly determined that somehow the calls were being surreptitiously inserted into the global communications network somewhere overseas—and absolutely nothing else. "Well—" he began.

"Oh, Sam, I don't see why you want to be a senator in the *first* place! Why don't you just retire and go fishing with Bruce and . . . and . . . just *stop* being a senator!"

Sam had to keep himself from audibly sighing a second time. How to tell Marianna—or Bruce and Emily—that the only reason he clung so tenaciously to this thankless job in Washington was that as a United States senator he could protect the three of them from the Federation and its lackeys a helluva lot more vigorously than if he were merely private citizen Sam Ferron of Eagle Nest Lake, New Mexico, population 768.

Or so he told himself. Right now he didn't seem to be doing a terribly effective job of it.

"We'll talk about it when I get home, dear. But I certainly do agree with you: there's got to be a better way of making a living."

Like finding out from Roderick Bantry how he was coming along with the public introduction of the scanner in London seventeen days from now. Sam told his commcent to call Bantry at his observatory office. A moment later he was looking at a printed message saying that Roderick Bantry was out of his office.

Sam grimaced in annoyance. It was hard enough trying to figure out when an astronomer might be at work in the first place; it was even harder when there was a six-hour time difference involved. "The hell with it," he muttered. "Call Bantry on his wristphone. Use the private emergency number."

To Sam's surprise, the face of Linda Rawlings peered out of his deskphone. Her mousy-brown hair, he saw, was as straggly as he had remembered, her eyes even more bulbous. "I'm sorry," she said, "neither Roderick nor I can answer your call at the moment, but if you leave your name and number we'll call you back as soon as we can." The screen went blank.

Sam sagged back in his chair, tugging fretfully at the loose flesh that seemed to be accumulating beneath

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his chin.

Linda Rawlings?

Rawlings was the Treasury Department snoop who had been assigned to keep the O-CLIP in Emily's clipper room from unauthorized use. She hadn't done her job very well. First Roderick Bantry, then ten-year-old Bruce Ferron, had managed to overcome her precautions with contemptuous ease. The bizarre upshot had been a disastrous affair between Roderick and Linda that Emily had discovered via her husband's prototype time scanner. Emily had filed for divorce—and Roderick had been forced to marry Linda in order to keep her mouth shut about his illegal use of the O-CLIP.

The hatred and contempt that Roderick had evinced for her a few short weeks ago had been unmistakable. Was it possible that he would ever turn his wristphone over to her to program?

Something was very wrong.

"You are due on the floor in seven minutes," reminded his commcent.

"Damn. Keep trying to get Roderick Bantry. Call every ten minutes. Call every number you have for him. When he answers, tell him I'll call as soon as I've finished my damn orating."

But four hours later Bantry still wasn't answering any of his phones—and Linda Rawlings's face was still turning up on his wristphone.

"Well," said Sam to his daughter that evening over his own phone, "I suppose he *could* be on his way to London with the people from the observatory and this is his way of being subtle and clever."

"Subtlety and cleverness aren't Roderick's strong points," said his former wife. "And even if they were, I can't believe he'd let that . . . that *creature* leave a message for him instead of doing it himself. Unless he was dying in a hospital somewhere."

"I know. That's what makes me nervous." Sam felt his eyes closing and his body being racked by an enormous yawn. "The hell with it. I'll keep after him all day tomorrow until I get him."

But the next day he was no more successful. "All right," he muttered at last, "now for the next step." He called first Seticorp and then the Keck Observatories on Mauna Kea.

"I'm sorry, Senator Ferron," said a puzzled receptionist ten minutes later, "but I can't seem to locate Mr. Bantry at all. He's *supposed* to be here. He was gone for the weekend, of course, but now it's late Monday afternoon here in the Islands and he's still not. . . . Did you try his home?"

"I've been trying his wristphone for two full days. And his home too. But I'll try again."

Still no answer. Sam drummed his fingers rapidly on his desk for a moment, then called his staff's legal assistance liaison, a terrifyingly competent lady whose actual job was to know everyone in Washington—and where their skeletons were closeted and their bodies buried. "Sorry to bother you so late in the afternoon, Ms. Dockerty-Dawson, but this is extremely important. I need to find a certain Roderick Bantry and/or a

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Linda Rawlings. Or the phone numbers where they can be reached. They're legally married but possibly informally separated. Here are the numbers I already have for Bantry; for Rawlings I've got nothing. If you could come up with something within twenty-four hours I'd be extremely grateful."

Twenty-four hours later nothing had turned up except three more hate calls to everyone in Sam's family.

Inwardly Sam raged. Outwardly it was hard to keep from manifesting some of that rage on the people around him. Sam fought for control as he considered what Ms. Dockerty-Dawson had turned up: nothing. Seven different phone numbers for Bantry and Rawlings—none of which were ever answered.

"One checked a little further," whinnied Ms. Dockerty-Dawson in her teeth-gritting voice. "It's strictly prohibited, of course, but if one speaks to *precisely* the right person, one *can* find out where a working wristphone is physically located, at least within a certain *broad* area. Those two wristphone numbers we're speaking of are now *somewhere* out in the middle of the Atlantic Ocean, about 900 miles west of *Portugal*. Wristphones don't work under more than two and a half *inches* of water, I am informed, so the most obvious explanation is that both phones are now on a *boat* in that general area." Ms. Dockerty-Dawson sniffed loudly in contemptuous disbelief.

Or in a watertight bag floating on the ocean, thought Sam bleakly, dumped there by people who didn't want Bantry or Rawlings found—but who didn't want their phones to conspicuously stop working either.

Sam spent the next six hours fruitlessly calling the seven numbers he had been given. After that he called the operations director of the FBI. "Judith? Sam Ferron here. I think that the present passive surveillance is no longer enough. No, I can't tell you why at the moment, you'll just have to take me on trust. Can you round up my family—Marianna, Bruce, and Emily—and salt them away somewhere for a while where *nobody* can get at them? Even if they come after them with an army? How about that fortress of yours in the Poconos? Yes, I'll call them this moment and tell them to be prepared to leave in the next thirty seconds. I truly thank you, Judith, I truly, truly do."

Sam broke the connection and slumped back in his chair, his mind numb with fatigue. What next? Only one thing suggested itself. He had to talk to the Federation. But how—and to whom?

Horst Helmstreit cast an amused eye at the several thousand naked people of both sexes at play on the golden sand that stretched as far as the eye could see. A dense growth of imported palm trees provided shade along one edge. Small gray rollers from the Gulf of Mexico lapped slowly against the other. Above, a furnace-like Sun burnt down from a cloudless blue sky.

"I didn't know you were a nudist, Sam," observed Helmstreit mildly, his

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slate-gray eyes appraising Sam's fish-belly white body and darkly tanned arms. "If you are, you're not much of an advertisement. Although I must say that aside from your color, you look in pretty good shape. Including your foot."

Sam glanced down at his barely discernible artificial left foot, the legacy of the encounter with painlusters nearly forty years before that had cost the lives of his first wife and her parents. He wiggled the prosthetic toes. "Yes, they get better and better every year. But I didn't come here for the sun."

"No? Then why?"

Sam turned around slowly, then held out his empty hands. He rubbed a hand over his gleaming scalp. "As you can see, Horst, I'm naked, there's nothing hidden on me, no recorders, no spyalls, nothing. And you'd better be the same. Otherwise the conversation ends here."

Horst Helmstreit nodded approvingly. "Very clever, old colleague. I see you haven't forgotten everything from the old days." His gray eyes swept the beach. "You have your men planted here?"

"Some of them are women, I believe. I imagine you have your own?"

"Possibly, possibly." Helmstreit held out his own thick brown hands. "What next? You can see I'm completely clean."

"Are you? Come over here a few steps. Good. Now lift your left foot and let me see the bottom. Quickly, Horst. Quickly!"

Helmstreit hesitated, then broke into a dour smile. "So!" he muttered, lifting his left foot to reveal a small, flesh-colored patch. "I cut my—"

"I'm sure you did, Horst. Just pull it off and throw it away over there."

"How did you know it was there?" demanded Helmstreit as he balanced precariously on one foot and stripped the patch away.

"When I was a kid I was fascinated by an old-time magician named Harry Houdini. One day I read that Houdini used to keep his picklocks taped to the bottom of his feet when he did his celebrated jail escapes. They'd strip him naked, search him all over, and never find a thing."

"Harry Houdini, ha! I'll remember that." The Austrian smiled benignly. "And now, Sam, shall we talk?"

"Yes. We'll walk out in the water as far as we can go and bounce around in the waves. That ought to prevent anyone else from listening in." Sam's right hand tightened powerfully around Helmstreit's upper biceps. "But first, Horst, let's also take a look at the bottom of your *right* foot."

Twenty-two years earlier, Sam had met Horst Helmstreit toward the end of the Great Sweep. Helmstreit was both the chief of Vienna's painluster investigation bureau and the Austrian liaison with Sam's painluster research center in Kansas City. Sam had spent three weeks in Austria while Helmstreit relentlessly rolled up one pain cult after the other. They had shared a few dinners together, a number of beers and coffees in sidewalk cafés. It had been nearly twenty years since they had last spoken. Now they

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bobbed together in the warm waves of Matagorda Island Nature Retreat, fifty miles northeast of Corpus Christi, Texas.

"Why me?" asked Helmstreit.

"Of all the people I've ever met who now work for the Federation you're the most senior. And the one I have the most friendly recollections of."

"All right, I'll accept that for the moment. But why are we meeting?"

"You checked me out as I told you to?"

"Your political career, your family, your life? Yes, of course. There are lengthy dossiers on you scattered throughout the world."

"Especially at the Office of Planetary Security."

"I don't work for the OPS, Sam, I told you that. I work for—"

"I don't care who you pretend to work for. You know everyone in the Federation. And everything that's going on in the world. If you didn't, you wouldn't have gone to work for the Federation in the first place."

Helmstreit nodded gravely. "Possibly, possibly."

Sam looped his still muscular arm around the Austrian's neck and pulled him closer. "The Senate filibuster on the Constitution, Horst," he whispered in a voice that was barely audible. "I might—*might!*—be willing to switch my vote. But only in return for certain guarantees from the Federation."

"Guarantees? For what?"

"The absolute safety of my immediate family, for starters. Now and for the next hundred years."

"I don't, of course, know what you're talking about, Sam, but I think I could guarantee that. Yes, I really think so. We're not tyrants, you know."

"We'll see. Next, I want Roderick Bantry and his wife back. Healthy, unharmed, and—this is most important, Horst—*unbrainscrubbed.* Do you follow me?"

"Not really, but supposing I did? Why might this couple I've never heard of be brainscrubbed? Assuming I even knew what that word meant."

"That's the other thing we've got to settle right here and now, Horst. Either you're going to tell me what the Federation plans to do about the scanner or there's no deal."

"The scanner?"

Sam let some of his smoldering rage boil over. "Horst, this is *me,* Sam Ferron! Stop fooling around! If you don't—"

Helmstreit looked at Sam with unblinking eyes. "Sam. I swear I don't know what this scanner thing means."

Sam considered the slab-like face skeptically. "Is it possible?" He unwrapped his arm from around Helmstreit's neck and let himself drift away in the warm Gulf waters. "All right then, I'll call your bluff. So go talk with someone who *does* know—and meet me back here in twenty-four hours."

The following day was, if anything, even hotter. Sam and Helmstreit bobbed together in the same tepid water, this time with a thick green cabbage leaf protecting the top of

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Sam's shiny skull.

"All right, Sam," said the Austrian, "I finally found someone who appeared to know what you might be talking about. It's the most closely guarded secret in the Federation. And from the little they told me, I can see why. This would be the most disruptive—"

"Horst, you, a former policeman, saying that? It would be the greatest thing for fighting crime that ever happened. Better than perceptualization enhancement even! It would wipe out crime and war forever! Isn't that what your precious Federation is being set up for? It—"

"It would lead to absolute dictatorship," declared Helmstreit flatly. "No one would *ever* have any privacy!"

"It would lead to absolute dictatorship if only *one* group of people had it—such as the Federation OPS. If everyone had it, though, then the *opposite* would be true—there'd be absolute freedom!"

"Freedom? Spying on—"

"Lying, stealing, crooked politicians? Not only to keep them from preparing for war, but from putting their hands in everybody's pockets? I know that's the Federation's real worry, Horst, just like it's going to be every politician's worry all over the world. So to save their asses, the scanner's going to have to be used under an absolutely rigidly defined legal code. There'll be licensed genealogists and historians who'll have access to it, laws about no peeping on living persons, regulations to—"

"Then what about policemen and wiping out crime and war, as you just said? How can they use it if—"

"Court orders, Horst, court orders. In Europe you don't have a tradition of them like we do here in the States. But picture yourself five years from now as chief of police in Vienna. You want to use your brand new scanner to see if Heinrich Q. Glockenspiel has just used a big shiny ax on his wife over on the Prinz Eugenstrasse. First you'll have to get a judge to issue a warrant for a scan on the basis of some concrete evidence or information, just the way you have to present a valid reason in order to get a search warrant today. Even if you *personally* saw him wielding the ax, you'd still have to get a court order."

"Umph." Horst Helmstreit sounded largely unconvinced. "In any event, Sam, that's not the way it's going to happen. Nothing is going to happen, do you understand, *nothing!* And that's all I've been authorized to say."

Sam took a deep breath, then let it out slowly. His worst fears had now been realized. "You mean you really *are* going to try to suppress it?"

"Suppress? That's not quite the word—"

"Well, at least keep it for the Federation—and the OPS."

"That I can't comment on."

"No, I suppose not. What about Roderick and Linda?"

"The Bantrys." Helmstreit pursed his lips. "I've been told to tell you that we know nothing about them, have never even heard of them, but that we will keep an eye out for them. And that it is possible—*possible*, Sam—that after the next vote in the Senate, if all goes well, who knows,

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maybe they might be found after all."

Sam looked at the Austrian with arctic blue eyes that were now glacially cold. "So you're going to disappear them, are you? Them and everyone else who's ever heard of the scanner?"

"Not you, Sam, and not your family. Not if. . . ." Helmstreit shrugged eloquently.

"Everyone at the Mauna Kea observatories, Horst? Everyone at the University of Hawaii? Everyone in the United States Senate? The royal family in England? You can't do it, Horst, not even the Federation can do all that."

Helmstreit sighed softly. "I have nothing more that I'm allowed to say, Sam."

"Then take this message back for me: You can't put the genie back into the bottle. Particularly when it's the most powerful genie since atomic energy."

"No? Well, it certainly seems as if we're going to try."

Sam threw his arms around both Marianna and Bruce and squeezed tightly. Emily stood to one side and watched with an indulgent smile. "Everything's all right?" he asked.

"It's wonderful!" enthused Marianna, gesturing at the eighty-room stone mansion that loomed behind them in the sunny forest clearing.

"Well, it *ought* to be wonderful. This is where they bring Presidents to protect them when assassination threats seem really serious. I think it used to be the summer home of a Mellon or a Carnegie."

"And they've got *two* O-CLIPs here!" marveled Bruce. *"Two!"*

"That's what I heard," said Sam softly. He lowered his voice even more. "Any chance of sneaking the use of one, even for a little while?"

Bruce shook his head. "I've been asking and asking."

"So much so that now they've posted a real, live FBI man in front of each of them," said Emily with a hard edge to her voice. "Ones that aren't Linda Rawlings, either."

Sam nodded. "And the one back at the clinic? Any chance at all of getting to it?"

Emily shook her head. "I've been meaning to tell you: it was physically sealed by three treasury agents with a court order about six hours ago. You'd need a crew of workmen and a truckload of power tools to get into it. I think the Administration *really* wants you to change your vote, Pop."

"Damn! That's what I've been afraid of: the final proof that the Administration is already in the hands of the Federation. Well. . . ." Sam sighed heavily.

Marianna squeezed his arm. "Sam, what *is* this all about?"

"I'm going to have to borrow Bruce for a while. And then we're going to have to find a functioning O-CLIP somewhere—secretly."

"But . . . but why?"

"The Federation is moving fast—and ruthlessly. The FBI tells me that eleven people who were professionally connected with Roderick in Hawaii have disappeared in the last twenty-four hours, just the way he and Linda have. We've managed to get the rest of them under protection,

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but it may already be too late."

"Then . . . then they really *are* trying to suppress—"

"Why do you want *Bruce?*" Emily cut in.

"I wish to hell I didn't, but he knows a thousand times more about computers than I do and I can't think of any other way of giving us even a fighting chance. And even *that's* probably the wrong word. The chances are one in a million that we can even get it to work—and then one in a billion that we can save Roderick and the others."

"Rod—" Emily faltered on the name of the man she had once loved.

"I don't *care* about Roderick," snapped Marianna, "I care about you and Bruce! Be careful, Sam!"

He nodded grimly. "I will," he promised, wrapping his arm protectively around his son. "But if we can't save Roderick. . . . " He broke off, unwilling to finish his sentence. . . . What chance have we got of saving ourselves?

Fourteen frantic hours later, Sam and Bruce stood in an instrument-laden room three miles from the French-Swiss border—and three thousand feet underground.

To no one's astonishment, the French, of all the Europeans, had been the most adamantly opposed to the delegation of even the slightest of national prerogatives to the Federation. Two governments had fallen, one prime minister had been assassinated, and a near-revolution had paralyzed Paris for three weeks before they had finally been coerced into joining their neighbors in surrendering vital parts of their sovereignty. It was not surprising that an underground network of anti-Federationists supported by the very highest political levels had come into being.

"We managed to keep one O-CLIP hidden from the Federation when they did their inventory of the Ministry of Statistical Analysis," said Colonel Lucienne Favre-Trognon with icy satisfaction. She was an attractive but grimly efficient military intelligence officer whom Sam had met two decades before during his pursuit of the world's painlusters. "We cannibalized enough so-called defective parts from all over Europe and Africa to make this one working model without, we hope, leaving any paper trail."

"Very efficient. We tried to do the same sort of thing in the States but I don't know how well we actually succeeded. And with the present Administration, anything we did hide will probably be turned over to them anyway."

"Politicians." Colonel Favre-Trognon curled a disdainful lip, then turned businesslike. "That suitcase there contains everything you need?"

"Almost certainly not. We brought it more to give you a demonstration than for anything else." Sam gestured at the four other military officers and three civilians who stood regarding him with openly skeptical expressions. "Once Bruce has shown what he can do with this four-year-old model, we hope to have bought your indulgence—as well as your expert help—in trying to link up with what Bantry says is now a global network."

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"And whether you succeed or not, you will leave us this obsolete . . . graviton reader did you call it?"

"Yes. That's the bargain we agreed to. Lend us your O-CLIP, we'll give you our reader."

"This still sounds like the greatest of nonsense to me," protested one of the civilians. "First you will have to demonstrate the reality of this . . . magical device."

Sam nodded. "Just let Bruce sit at the controls of the computer and I'll start feeding him data from the reader. But don't expect too much. This is the same old reader Bantry left with us at the clinic four years ago—as I recall, its final range was only about seventy feet and forty-two hours into the past."

But a few minutes later that was enough to elicit astonished cries from some and stunned silence from the others. "That . . . that really *is* me walking into the room yesterday morning!" Colonel Favre-Trognon stared incredulously at the jerky, black-and-white image of herself on the computer's monitor. "Look, you can see from the headline that I'm carrying yesterday's *Figaro!*"

Bruce reluctantly turned the controls over to a French computer expert, then stood behind him fidgeting impatiently while the officer slowly moved the image on the monitor out into the nearest corridor and then nearly two days into the past.

"But we're buried here under *one thousand meters* of the Jura Mountains," shouted one of the officers petulantly. "How can these . . . these *gravitons* do . . . penetrate . . . reveal . . . do. . . ." He sputtered off into baffled silence.

"I don't know," said Sam. "And I don't think Bantry does either. And all I know about gravitons is what I've had drummed into me: that they have an indefinitely long lifetime, zero electric charge, and zero rest mass. And that just as there's no light without photons, there's no gravity without gravitons."

"But still it works," marveled the man at the controls, "still it *works!*"

Sam allowed himself a thin smile. "It works if all you want to do is look at a hidden room somewhere under the Jura Mountains. What I hope is that you and Bruce can extend its range a trifle."

Thirteen hours later Sam's one chance in a million galloped triumphantly home.

The Office of Planetary Security had been less than 100 percent efficient in their sweep of Roderick Bantry and his colleagues in Hawaii. Seticorp's O-CLIP computer had been disabled and all of the personal or professional computers used by the dozen missing scientists destroyed or stolen. But Bantry had been a conspirator for too many years now to be so easily thwarted: it was Bruce who eventually found a Bantry-devised password guarding a file hidden in a Bank of Hawaii computer in the Big Island resort town of Kona-Kailua. After that, accessing the file from halfway around the world was nearly instantaneous.

The file contained all the information needed to link an O-CLIP computer with the six tiny graviton read-

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ers presently circling the Earth in geosynchronous orbit. It was another twenty minutes before the monitor displayed a now ultra-sharp—though still black and white—image of the general chairman of the Council of Nine having an intimate dinner in the private dining room of a Swiss *auberge* with a young lady who was manifestly not his wife.

"Track in on that date on the menu," directed Colonel Favre-Trognon. "Thirteen May, 2073—fifteen months ago!" She stood rigid before the screen, then whirled and threw her arms around Sam. Before he could react, she had kissed him once on each cheek and then a second time. *"Mon Sénateur,* you've done it, you've done it! We now have a weapon to fight the Federation! *Je vous salute!"*

"After that it was like shooting ducks in a barrel," said Sam to Roderick Bantry. They were strolling slowly through the sun-dappled paths of the hardwood forest surrounding the Pocono safe house. Somewhere within the bowels of the mansion were Linda Rawlings and Bantry's Big Island co-workers.

"You got me back, Sam," said Bantry huskily, his eyes intent on the narrow trail. "I'll never forget that. They were just about to start interrogating us with perceptualization enhancement, you know. I don't know why they'd delayed it. They'd already used it on Linda three weeks ago after she'd blabbed too much to the wrong person at a fashion show in Milan, the bitch. That's how they found out about the scanner in the first place."

"I was wondering about that."

"After the PE I don't know *what* they were going to do with us. It takes a trained expert like Emily a lot of time to wipe out even a tiny portion of a memory using an O-CLIP. So why would they bother when there's such a simpler way?"

Sam nodded somber agreement. "And if they'd interrogated you right away under PE you'd have told them about that backup file in Kona."

Bantry shuddered. "And you'd never have figured out how to access the readers. And I'd be...." He gulped audibly and tapped the forest floor with the tip of his shoe.

"Maybe, maybe not. I think there was at least a fighting chance that Bruce and the other computer types might have figured it out on their own."

"Whatever. I owe you, Sam, you and Bruce, I really owe you." Bantry shook his head as if still marveling at the narrowness of his escape. "But how did you *do* it, how did you get them to just let us go?"

"It wasn't pretty," said Sam, stopping to lean against the trunk of a particularly imposing oak and study a patch of hazy blue sky, "and I'm not particularly proud of it. But I couldn't think of any other way of doing it. What we did was to make a list of every reputed scandal or aspersion or embarrassment that had ever been linked to any of the members of the Council of Nine, as well as a dozen or so other Federation movers and shakers, including the top four people in the OPS."

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"You mean all the dirty linen—"

"I'm afraid so. With the French intelligence service working with us it wasn't very hard to get a list of hundreds of rumors, stories, and innuendos. After that it was just a matter of tracking some of them down." Sam shook his head despondently. "You'd be depressed at how many of the really awful things that were alleged about some of the very best of them were actually true. The scanner does not give a pretty picture of the human race, Roderick."

Bantry turned away to hide the flush that reddened his cheeks as he remembered his own horrible humiliation of four years before. Without the pitiless testimony of the scanner, he knew, he would still be married to the only woman he had ever loved. "Don't rub it in," he muttered.

"Rub it in? What do you . . . oh. No, I was thinking about . . . about other things."

About the second-in-command of the Office of Planetary Security who had somehow managed to conceal his youthful activities as a member of an Australian pain cult.

About the Council of Nine member who *had* locked his first wife in a cellar dungeon for three months until she had consented to a divorce, just as rumor had always said.

About the justice of the High Tribunal who really *did* spend occasional weekends in the company of very young boys, the younger the better.

About the Federation's new Minister of Environmental Coordination who really *had* squirreled away $7 million in a Liechtenstein bank account for his role nine years earlier in the coverup of the Paraguayan Black Death.

And most shocking of all, about Maheyna Mbluhei, the revered Executive Secretary of the Council of Nine. Thirty-seven years ago, the nagging innuendo had it, this saint-like creature who had lifted herself to the presidency of Kenya by her tireless efforts on behalf of the children of Africa, had participated in the massacre of an entire village of dissident tribesmen on the Lotagipi Swamp.

Silently grieving for the human race, Sam had watched the truth unfold on the O-CLIP's screen. It reminded him of the painluster horrors he had once devoted his life to expunging. The truth was stark and simple. And just as the rumor had said.

"I felt slimy," muttered Sam, "dirty, *awful* at having to watch the things we saw. But we had to, Roderick, we had to—if we wanted to get you back."

"I know, Sam. And I'll never forget—"

"Oh, it wasn't just for you that I did it. It was for everyone else, like those poor villagers who got themselves massacred by Her Holiness. And for all the other poor people who right now are getting themselves screwed and murdered and robbed by gangsters and politicians and petty warlords all over the world, and who never get a break from anyone. *They're* the ones I did it for, Roderick, *they're* the ones who need the scanner to protect them, all the little people of the world." Sam pushed himself

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away from the tree, his face bleak. "And by God, Roderick, I'll see that they get it!"

Bantry stared at him wide-eyed, half-frightened by the intensity of Sam's grimness. "And that's what you told them, Maheyna Mbluhei, and all the rest? You just out-and-out *blackmailed* them? You blackmailed the entire *Federation?*"

"What's worked for me before will work again. Anyway, we didn't call it blackmail, we called it a political negotiation. We—I and everyone in that room under the Jura Mountains—will forget about everything we saw—and recorded, Roderick, recorded very, very thoroughly—and they'll forget about trying to suppress the scanner, at least entirely. We drew up a protocol about how it'll be allowed to be used, with certain restrictions, but right now I can't remember all the details. You'll be reading about it soon enough. After—"

"After what, Sam?"

"After you've been to London to introduce the scanner to a breathless world, Roderick. And, I imagine, particularly after you've been to Stockholm someday to pick up your Nobel." Sam took a step onto the path that led back to the old stone mansion and his wife and children. "And maybe someday you'll remember what it cost."

"Cost? What do you mean?"

"Do you know what I was thinking, Roderick, as I watched all those horrible things on the scanner?"

"Well, I suppose that—"

"I was thinking that the very reason the Federation wanted to outlaw the scanner, Roderick, to suppress it without any consideration at all for all the good it might do, was because of the threat of the exact use to which I was putting it. Using it to spy and snoop and destroy lives and careers, Roderick. Using it for exactly the things I *don't* want the Federation to use it for. But in order to keep *them* from doing it, I had to do it." Sam uttered a sharp bark of what might have been laughter. "How do you like that for cost, Roderick?"

Bantry shook his head slowly. "Frankly, I don't quite understand."

"No? Well, you and Emily never had any children, did you? So you don't know how bad it can be. But then, no one ever said that giving birth was easy."

Marianna and Emily and Bruce were still in the Poconos. It seemed to Sam that until the ratification of the Constitution had finally been settled one way or the other, it was safer that way.

Until, he knew, he had delivered his own final part of the bargain.

It was the afternoon of September 29, 2074. For the fourth time since the formal debate had begun five months earlier the roll call of the senators was read as the Administration tried yet again to invoke the cloture that would make the Federation the supreme power in the world.

Sam paid little attention to the ongoing Ayes and Nays. He knew that no one had changed their minds in the nineteen days since the last vote.

"Dominguez."

"Aye."

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"Duong."
"Aye."
"Edwards."
"Nay."
"Fairly."
"Nay."
"Farr."
"Aye."

Sam sat hunched in his seat, his eyes closed, the list of senators clear in his mind. No, no votes at all had changed. Cloture would once again be defeated by 41 nays, the filibuster carried on, the sovereignty of the United States preserved.

"Ferron."

Samual Garraty Ferron took a deep breath and hunched his shoulders even further, as if willing himself into total invisibility. Without opening his eyes, thinking only of the brave new world of the time scanner to which he was helping give birth, he whispered, "Aye." ■

EDITOR'S NOTE: This story is a sequel to "Under the Wings of Owls," January 1994; "To Change a Memory," March 1994; and "Pandora's Scanner," June 1994.

I have always been among those who believed that the greatest freedom of speech was the greatest safety, because if a man is a fool the best thing to do is to encourage him to advertise the fact by speaking.

Woodrow Wilson

The immature man wants to die nobly for a cause, while the mature man wants to live humanely for one.

Wilhelm Stekel

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THE ALTERNATE VIEW John G. Cramer

BEAUTY AND THE B-FACTORY

The galaxies, stars, planets, and people of our Universe are made of matter, not antimatter. This is a conclusion deduced from the convincing indirect evidence of cosmic ray studies and astronomical observations. There are a few antiprotons in cosmic rays but no sign of an antiproton solar wind from anti-stars or anti-galaxies, no gamma rays from nearby anti-planets or asteroids or from great annihilation interfaces where matter and antimatter come violently together in intergalactic space.

Yet normal particle interactions produce matter and antimatter in equal amounts. If matter and antimatter in the early Universe had been in perfect balance, they would long since have been annihilated out of existence, leaving behind a Universe of photons and a few electrons. We would not be here to study such a Universe, since our very existence depends on the gross excess of matter over antimatter now present. Where did the matter come from? What happened in the early stages of the Big Bang that produced the contemporary dominance of matter?

The short answer to these questions is that we don't know. The Standard Model of particle physics can accommodate a matter preference (called a "charge + parity" or CP violation). However, in the Standard Model the CP violation is characterized by a single parameter, and the underlying mechanism is not understood. We do not even know if all aspects of CP violation that seem to be wired into our Universe can be fitted into the Standard Model. The path to better understanding requires new experimental data that must be obtained by studying an exotic flavor of heavy quark, the "bottom" or "beauty" quark as it behaves in a very peculiar particle, the B^0 meson.

In 1968 James W. Cronin and Val L. Fitch of Princeton University and their group working at Brookhaven National Laboratory discovered a CP violation in the decay of K_S (or K-short) mesons. This breakthrough experiment, which earned them the 1980 Nobel Prize in Physics, was one of the most surprising and unexpected discoveries of 20th century physics. Before discussing B mesons we will look a bit deeper into the CP violation as it was discovered in K mesons.

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At the quantum level, nature seems intolerant of identical twins. Whenever twin "states" of a quantum system are so similar as to be indistinguishable, they mix together to produce two other states that *are* distinguishable. A well known particle physics example of this prejudice against twins is the quantum mixing of the K^0 meson with its antimatter twin the K^0-bar.

The K^0 has a mass of 498 MeV in energy units, intermediate between that of an electron (0.511 MeV) and a proton (938 MeV) and might be considered the light-weight little brother of the B^0 meson (5,279 MeV) which is described below. At the quark level, the K^0 is made of a "down" quark (matter) and an "anti-strange" quark (antimatter). Similarly, the K^0-bar is composed of an anti-down quark (antimatter) and a strange quark (matter). Both K^0-s have no electrical charge, zero intrinsic angular momentum (or spin), and precisely the same mass. Thus we have two particles with very different (and opposite) internal structures but with the same charge and mass. On the basis of these observables they are indistinguishable twins.

Since nature doesn't tolerate identical twins in quantum states, the two indistinguishable K^0 states mix to form two new states that *are* distinguishable. The K^0 and K^0-bar are scrambled together. What emerges are two new mesons, the K_S meson (K-short) with the short decay half-life of about 10^{-10} seconds and the infinitesimally heavier K_L meson (K-long) with a half-life of about 5.2×10^{-8} seconds, about 581 times that of the K_S. The K_L and K_S masses differ by only about three one-millionths of an electron volt.

Fitch and Cronin discovered that decay of the K_S meson into lighter particles violated some of the most cherished symmetry principles of theoretical physics: *parity* (i.e., mirror-image symmetry), *charge conjugation* (matter-antimatter symmetry), and *time-reversal invariance* (the symmetry of time-running-forward vs. time-running-backwards). The K_S decay showed a definite preference for "left-handedness" over "right-handedness." Later experiments indicated that the decay of a K_L into $\pi\pm$ mesons and electrons or positrons showed a tiny preference for $\pi+$ over $\pi-$ (matter over antimatter) and for one direction of time over the other. If a movie were made of certain particle reactions involving the K_L, one could in principle tell if the film were running forwards or backwards through the projector.

Cosmologists realized the implications of the preference for matter particles in the K_L decay processes: if this kind of imbalance were present in some particle decay processes in the early Universe, it could explain why more protons than antiprotons were created in the Big Bang. After most of the protons and antiprotons had annihilated each other, the leftover protons (about one per million) would account for the dominance of matter in the Universe today.

There is, however, a conspicuous flaw in this logic: the K_L has a mass that is only about half that of protons

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and neutrons. From simple considerations of conservation of mass-energy, there is no scenario under which today's protons could have been created in K_L processes in the early Big Bang.

However, the lesson learned from K_L decays is instructive. If there were a similar particle more massive than a proton that also exhibited a preference for matter similar to that shown by the K_L decay, we might have the ancestor of all modern protons and neutrons in the Universe. And, as it turns out, there probably *is* such a particle—it's the B^0 meson.

The B^0 has a mass of more than 5 proton masses and decays with a lifetime of about 10^{-12} seconds (about 100 times faster than the K_S). There is preliminary evidence that the B^0 meson and its antimatter twin, the B^0-bar meson, mix to form a B-long and a B-short, mixed particles similar to the K_L and K_S but much more massive. If the hypothetical B_L and/or B_S shows a preference for matter over antimatter similar to that found in the K^0 system, this could explain what happened in the first stages of the Big Bang to create the present matter-dominated Universe and would also give a new and independent look at the nature of CP violations.

There have been attempts to study the B^0 system using existing particle accelerators, but the very small probability of producing these exotic particles has limited what can be learned. What is needed is a dedicated high-current accelerator to produce B mesons and some years of experimental measurements on B^0 decay processes before data and answers are in hand. The Department of Energy has recently announced plans to build such a dedicated accelerator. It will collide electrons and positrons in a way that will produce enough B^0s to address questions at the heart of the matter-antimatter imbalance.

There was strong competition between the CESR (Cornell Electron Storage Ring) laboratory at Cornell University in upstate New York, supported by the National Science Foundation, and the SLAC (Stanford Linear Accelerator Center) laboratory operated by Stanford University in Palo Alto, California, supported by the Department of Energy, for approval to construct the new B-factory. Although Cornell's proposal was less expensive, a review committee decided that the SLAC proposal had the greatest scientific merit, and recommended construction of the B-factory at SLAC. When President Clinton visited California last fall, he made a special stop at SLAC to announce that they had won the competition and had received the go-ahead to construct the new machine.

How do you mass-produce B^0s in a factory? The trick is to produce bottom (or as the Europeans say, beauty) quarks in matter-antimatter pairs that can then combine with more ordinary down quarks to make B^0s and B^0-bars. The b-quarks were discovered by Leon Lederman and his group by producing the upsilon or $\Upsilon^0(1S)$ meson, a special particle state with a mass of 9,460 MeV in which a bottom and anti-bottom quark are locked together in a tight mutual orbit. How-

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ever, the $\Upsilon^0(1S)$ meson cannot decay into a pair of B^0s because it does not have enough mass-energy. Fortunately for B physics, there is another state corresponding to a higher orbit of the b-quarks, the $\Upsilon^0(4S)$ meson, which has a mass of 10,580 MeV, just 22 MeV more massive than a pair of B^0s. About half the time a $\Upsilon^0(4S)$ meson decays to a B^0 + B^0-bar pair, so that the production of B^0s is very efficient.

There is, however, another problem: the B^0 mesons that are produced decay from a near standstill in about 10^{-12} seconds (perhaps a bit longer in the case of the B_L), making it very difficult to study the decay products. The solution to this problem is to "boost" the whole decaying system in order to give the decaying B particles and their decay products a significant forward velocity. This is done by using an asymmetric particle collider, i.e., using two particle beams (electrons and positrons) moving in opposite directions and brought into collisions, but with one beam made considerably more energetic than the other. The SLAC design for the B-factory will modify the venerable PEP storage rings for asymmetric collisions, bringing 9 GeV electrons into collision with 3.1 GeV positrons with a luminosity (in effect, collision probability) of 3×10^{33} cm $^{-2}$ sec $^{-1}$, about 50 times greater than that of the old PEP storage ring. The B-Factory project was included in the new Department of Energy budget just presented to the 1994 Congress. It will cost a total of $273 million in construction funds to be spread over five years. It will go into operation in about the year 2000.

What will be learned from building yet another particle accelerator? The Standard Model of particle physics (which has recently been called TONE, the Theory Of Nearly Everything) works very well but contains some 17 adjustable parameters with values that must be "put in by hand" rather than derived from more fundamental principles. To make any further progress in understanding the underlying structure of our Universe, we need to somehow get beyond the Standard Model. There are currently three major attempts to do this: the RHIC project at Brookhaven which will attempt to break the Standard Model with the extremely high energy densities produced by colliding heavy nuclei, the LHC project at CERN (successor of the SSC) which will attempt to break the Standard Model in the "Higgs sector" by searching for H particles embodying the splitting of the strong and electroweak forces, and the newly begun B-Factory which will test the most peculiar aspect of the Standard Model, its CP-violating processes.

In the coming decades, experimental physicists will be working very hard to test to destruction the theory that presently gives us the best description of our Universe at the most fundamental level. It's going to be fun to watch, and even more fun to participate. ■

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Tom Ligon

DEAR COLLEAGUES

"Behold the tortoise—he maketh no progress unless he sticketh out his neck!"

Illustration by Laura Freas

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As you no doubt have heard by now, I quit.

Now, I'm sure most of you think old Erica Thompson is a prima-donna. (it's true), especially since she got that little award. You probably think she's just in a snit over a raise or something. Actually, this had been a long time coming, and it has almost nothing to do with money. In particular, I was offered a job a few weeks ago, one I would have snapped up in a minute when I was fresh out of school. I've sort of gotten used to my cozy lifestyle, though, and I was going to pass it up.

Until this morning.

I was up until two this morning working on a new proposal. Consequently, I overslept. That got me into a rush, and I came down the stairs a little too fast. Naturally, the motion detector at the bottom of the stairs interpreted that as a fall, and deployed the air-bag.

I knew instantly that I had to call the local rescue squad to let them know it was a false alarm. Since it would be against the law to call 911 for this purpose, I had to call the normal number. It was busy. By the time I got through, they had already dispatched an ambulance and rescue vehicle, which means I'm stuck with a five-hundred dollar fine.

I was mad at myself for being so careless, but I was inclined to chalk it up to experience and get on with the day. I headed into the kitchen for a container of fat-free, cholesterol-free, salt-free, high-fiber, toxin-screened, FDA-inspected. AMA-accepted, UL-listed, nutritionally labeled, high carbohydrate fuel for *Homo sapiens.* Blueberry flavored, my favorite. Then I stepped over to the utensil drawer for something to eat it with. I fumbled with the child-resistant catch, and opened it to find nothing in the drawer but spoons.

Of *course,* you say? What *else* would you have in a utensil drawer? Friends, I remember when we also used knives and forks to eat with. That's right, we used to put four-pointed implements *right into our mouths,* back before the Insurance Institute for Culinary Safety managed to get them banned.

Anyway, I grabbed a spoon and my briefcase, resigned to eating breakfast in the car again, and headed out to the garage. I was grateful, for once, to just be able to tell the car my destination and have it handle the driving while I choked down the tub of mush and looked over the proposal in perfect, computer-controlled, NHTSA-mandated safety.

I reached the Institute with minutes to spare before presenting my proposal to the review committee. I caught myself running down the corridor, fortunately *before* any alarms took notice, and reached the conference room a few seconds before the appointed time.

Dr. Prunebottom—and yes, since I'm quitting I will call everyone by their accepted nicknames, and maybe someone will tell Prunie how he earned *his*—glanced at his watch. "By the hair on your chinny-chin-chin, for *once,* Dr. Thompson. What wild and mysterious rending of the laws of physics do you propose *this* time?

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I passed out copies of my proposal. "I want to modify the Higgs field generator for a much smaller and more intense field. I think I can get the Supercollider's collision cross-section up enough to have a significant chance of getting to within an order of magnitude or so of primordial density, at least on a sub-nucleonic scale."

Dr. Pigwhistle was aghast. "After the havoc you caused *last* time?" She held up an invoice and shook it in my general direction. "We had to replace all the detectors in the collision chamber. And you want to go *further?*"

I nodded. "That's right, I do. I think I'm on the verge of something really exciting."

Dr. Ruth—see, Ruth, your nickname isn't all that bad—glanced over the proposal. "Well, Erica, I see you've included a more . . . shall we say . . . robust? Yes, a more robust detector and field generation assembly. Substantially so. Ought to be capable of soaking up quite a blast, in fact. Now, Erica, I know *you* have a Nobel prize and I *don't,* but the fact is that you either can't or *won't* explain why these reactions are so violent. From what I can tell, you expect a *geometric* increase in output from the last run."

I shrugged. "Not immediately. The detector is over-built for the present proposal. I'm hoping, however, to demonstrate a radically new physics that will lead to advanced and extremely powerful propulsion systems."

Prunebottom pursed his lips and puffed out his cheeks in that expression he thinks conveys disgust but which actually cracks us up. "This wouldn't have anything to do with that wild-assed idea of yours that there is a form of energy faster than light, would it?"

I grimaced. One tiny little paper as an undergraduate, and your peers label you as a crackpot for life. "Let's just say I think I'm on to something hot, but something which no responsible scientist would believe without convincing proof. I think I've done it already, but the detectors couldn't take it so I lost my data."

"Sounds to *me,*" Prunebottom snorted, "like you're messing with the fabric of the Universe."

I put my face in my hands and my elbows on the table. "Here we go again. The Trinity wager. What are the odds the first atomic bomb test will trigger a fusion reaction of the atmosphere and blow up the world? What are the odds that Erica Thompson, in approaching the conditions of the Big Bang, will snag a thread of reality that makes all of Being unravel. Guys, I thought we *built* the Supercollider to investigate that corner of physics."

Pigwhistle wheezed a couple of times—my dear, you do it with every anxiety attack, which is how you earned the nickname. With a quavering voice, she offered this gem. "Please don't repeat it outside this room, but I always felt we *really* built the Supercollider to keep high energy physicists off the street. Frankly, we're already so far ahead of the technological capacity to *exploit* what we

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learned with the *last* generation of accelerators, I wonder how we can justify what we're spending on *this* one."

I picked my head up out of my hands. "Approve this proposal, and, if I'm right, I'll justify it a thousand times over."

"Justify, shmustify," Prunebottom retorted. "We deal in pure *science.* But our esteemed bean-counting colleague here is right that there may be no big payoff other than knowledge. That being the case, it behooves us not to charge ahead carelessly with experiments which could be unimaginably dangerous. After all, the goal is *knowledge.* The way I look at it, by cautiously progressing one step at a time, waiting for peer review and confirmation, testing alternative hypotheses which would explain the data, in other words by doing good science, we should be able to reach Dr. Thompson's goals in, say, twenty to thirty years."

The others nodded agreement.

"OK, then," Ruth said, pulling out her calendar, "I think we should convene a preliminary safety review board to examine the methodology used in the last test, and to propose a retro-design to back off Dr. Thompson's parameters. . . ."

I got up slowly and trudged out of the room, unable to watch as they castrated my proposal. I headed back to my office and spent an hour in a total funk. Finally, my head cleared and I began to examine the problem rationally.

The problem, as I now understand it, is that the whole damned country has gone to hell. And, I am ashamed to say, so have I. As individuals and as a society, we have become afraid to take risks. Each of us has come to believe that our own life is somehow important, and we've become so obsessed with protecting our self-important asses that we virtually eliminate any chance of accomplishing anything meaningful.

Remember the argument for eliminating forks? After a prime-time exposé of the disgraceful cover-up by the utensil industry of the number of injuries a year attributable to forks, the safety officials came out with their usual line: "Every life is precious." Mind you, other than prisoners sharpening fork handles into knives, I don't think they actually came up with any deaths, but hey, the *potential* was there.

I suppose we should have seen this coming. When I was a kid, physical education classes meant playing ball, running, jumping, and all that. Today, it means fifteen minutes of low-impact aerobics plus a lecture on the importance of exercise. School sports programs were eliminated long ago due to the insurance and liability problems. (Funny thing is, I don't remember very many kids dying of heart attacks when I was small but it is a growing problem *today.*) General aviation died long ago, killed by runaway liability claims and regulations designed to prevent any possibility of an accident *ever* happening. Most people didn't mind, since most people were scared of little-bitty airplanes anyway. Then, using about the same logic, they eliminated human control of automobiles. That caused

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quite a squawk, but it passed, because certainly the risks far outweighed the dubious joy of using your own skill and judgment to get from one point to another.

When I was in college, some of my friends liked to climb sheer cliffs with nothing but their toes and fingertips to hang on with. I had other friends who not only went up in little-bitty airplanes, they jumped *out* of them, just for fun. There were people who jumped off bridges with big rubber shock cords tied to their ankles. I had a motorcycle for a while, and I loved riding through white-water rapids on a rubber raft. Try doing any of that today, and if you aren't arrested for it, you will at least lose your insurance coverage.

Do you old-timers remember the *Challenger* disaster? We all *knew* spaceflight was dangerous. Then, suddenly, we knew it for *real.* Seven people died. Tragic, but, if you will excuse my saying so, *big deal!* Throughout history, in enterprises both great and small, people have died in much greater numbers. But this time, instead of pressing on with renewed determination to make their sacrifices meaningful, we paralyzed the space program with the attitude that we must never again have another accident because *every human life is precious.*

Folks, the more we believe that, the less true it becomes.

And I have been just as guilty of it as the next person.

Until now.

Let me tell you about that job offer I almost turned down. You are certainly aware of the pilot asteroid mining project timidly initiated ten years ago. The discovery of relatively abundant rare earths, particularly scandium, in certain asteroids, plus the unprecedented demand for those elements for such applications as high temperature superconductors, picoaccelerators, gamma-pumped electron cascades, and other engineered ceramic molecules, put a strong economic incentive behind the project. In fact, most economists believe that these materials are absolutely crucial for meeting Earth's energy needs. A massive terrestrial mining effort sufficient to meet current demand would be environmentally unacceptable, even if the nimbies permitted it. It looks like we've finally found a good substitute for beaver pelts in space.

You *did* know this country was built on the beaver-pelt business, didn't you? I read that somewhere when I was kid.

Of course, production is still low, in part because transportation is so slow. The piddly little electric rockets they presently use take too long to move too few supplies and people up, and refined rare earths back down. Fortunately, UNASA, not being the encumbered behemoth of its US counterpart, is acting more as a coordinating body for interested investors. *Very* interested investors. They think they're going to get unspeakably rich, and don't mind if a few poor souls have to stick their necks out to do it.

God bless their greedy little hearts.

Some years ago I was on a commit-

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tee to develop concepts for a fusion-powered spacecraft. Based on a variation of a Higgs-field reactor design of mine, we came up with what we thought was a practical proposal. However, NASA is only interested in exploration, not exploitation, and the robots we were sending into deep space were patient types. So were the people who had job security monitoring the data for years and years. Quicker spacecraft were considered a threat, not a priority.

My, how things change when a gold rush is on. UNASA wants me to head a project to build a fleet of big, fast, fusion-powered freighters. Notice, I didn't say they want me to head some management group in an office in Milwaukee. I mean they want me to actually go *up* there and make it *happen*. Friends, I would have killed for a job like this just a few years ago. But, until this morning, I was going to turn them down.

I've built myself a comfy life here. Safe, secure, predictable. I have prestige, money, and all the free chicken dinners I care to attend. Space is dangerous and the accommodations are spartan. The money would be great, but there is nothing up there to spend it on.

At this moment, quite literally, I wouldn't pass this job up for the world. And I'm hiring, if you agree with me.

I'll be honest with you about the ordeal you'll be getting yourself into. The belt miners are shipping back only the rare earths. They have been producing and stockpiling the by-products: enormous quantities of engineering materials too massive and low in value to transport back. We will be going where the materials are. There is some basic manufacturing capability there already, and we will be taking all the tools we can, but it will be a bit like setting out for the west with a crosscut saw, an axe, and a plow.

By the way, this is a one-way ticket: If you want to come back, or bring your family up, you have to build the ship to do it. That's the employee incentive plan.

Unless you are a space nut like me, you may be amazed at what is available up there. The belt has about every non-volatile material you could want, if you don't mind the materials being a little raw. The belt is a lot sparser than most people envision, but it is huge, and the amount of material, compared to minable materials in Earth's crust, is staggering. There is a project underway to exploit comets for volatiles (mostly water, carbon dioxide, nitrogen compounds, etc.). The goal is self-sufficiency, to eliminate the enormous cost of launching supplies to the belt.

The trip out will take about two years. We will design our construction facility and prototype freighter on the way. It must be something we can build with minimal support from Earth, and it must be durable and repairable. I suspect we will also settle for something a lot *simpler* than anything a team on Earth would design. We will be licensed to copy any design on Earth, but we'll have to *build* it ourselves. Consequently, we need people who are not only willing to

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get grease under their fingernails, we need people who can make their own grease.

No specialists need apply. We need almost all fields of expertise, and we won't have nearly enough people for one of each. Initially, a few hundred of us will be doing work that NASA would probably use a few million to do. Everybody will become expert in whatever is needed. Oh, and no lawyers need apply. We'll probably get three times as much done without them.

This will be a workaholic's dream job. There is nothing to do but work, and an unending amount of it to do. At first, it will seem like we are constantly reinventing the wheel. Small tasks will be much more difficult than on Earth. Example: we will take tools for resharpening hacksaw blades.

On the other hand, you can have anything you want if you are willing to build it from raw materials. Just tell me how much asteroid steel you need, budget your time, and it is yours.

There probably won't be much of it for a while, but most of your free time you will probably spend building and maintaining your habitat, growing food, inventing conveniences, and even running your own businesses. The belters have developed their own economy, based on a unit of currency called, of course, the "credit." They buy and sell services, parts, equipment, food, entertainment, whatever.

All you need to run an economy is energy, raw materials, and human talent. In the belt, the third element is the one in short supply. If we attract the talent and enthusiasm I think we will, the progress will be phenomenal. I am tempted to say it will be unlike anything ever seen on Earth, but I'm not sc sure.

Our work place will be modeled on the Skunk Works, the legendary facility that built the U-2, SR-71, and Aurora, and their magnificent successors. The philosophy there was to give talented, hard-working people responsibility for a particular task, the authority to get what they needed done, and autonomy to work unmolested. That facility managed to build, almost from scratch, aircraft that were twenty years or more ahead of anything else flying. They invented new technology to do it, they did it faster than anyone else thought possible, and they did it elegantly.

The pioneers with their saws and axes, and the engineers at the Skunk Works, are the sorts of people who made America great. The chunk of real estate they occupied had little to do with it. Today, most of the occupants of that patch of land are fat and timid. But there are still a few, in this country and around the world, of the kind of people who made "American" a label to be proud of. Space will be populated by them. At this moment, I can't bear the thought of hanging around down here while something like that is going on. I'd like to think I am, after all, an American.

Consider, if you will, the Old World backers of New World exploration. They expected to acquire great riches—gold, beaver pelts, and so forth. They had no idea of the tre-

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mendous wealth they would produce. But, that wealth stayed, for the most part, in the New World. The New World was, itself, the thing of value. That is what is going on here. Earth thinks it will profit greatly from the scarceium we will ship back, but compared to what we will build, it might as well be material for high-fashion hats. The big difference is that no native populations or furry critters need to die for us to succeed.

Now consider your prospects if you remain here. You will be safe and comfortable, I suppose, but your opportunities will be rather limited. You will be competing with about ten billion people for a finite pool of land, air, water, sunlight, and other resources. It is a sum-zero game with an increasing number of players.

I'd like to continue my present line of research eventually. The review board may be right. Maybe this planet *isn't* the right place for my experiments, and if they work, I'd have to take the technology into space to exploit it anyway. I'd like the chance to build some really hot rockets, and I don't know that I would get the chance in my lifetime if I stay down here.

If you understand why I'm taking the job, and if you want to come along, call me at 555-7263 for an interview. I'll be taking applications in room 201 of the Holiday Inn just down the road for the next week or so. Just remember, I've worked with most of you. I know which ones of you can wield a wrench and which ones are pure theoreticians. I know who thinks they're too good to clean a toilet and who steps in to do whatever needs doing. And I know who has the talent and desire to do it all.

So, who wants to join me?

Sincerely,
Erica Thompson ■

Venus was known to the ancients and she still attracts a lot of attention, especially when she is an evening star. Hardly an evening passes that somebody doesn't point up at her and exclaim, "What is *that?*"

Will Cuppy

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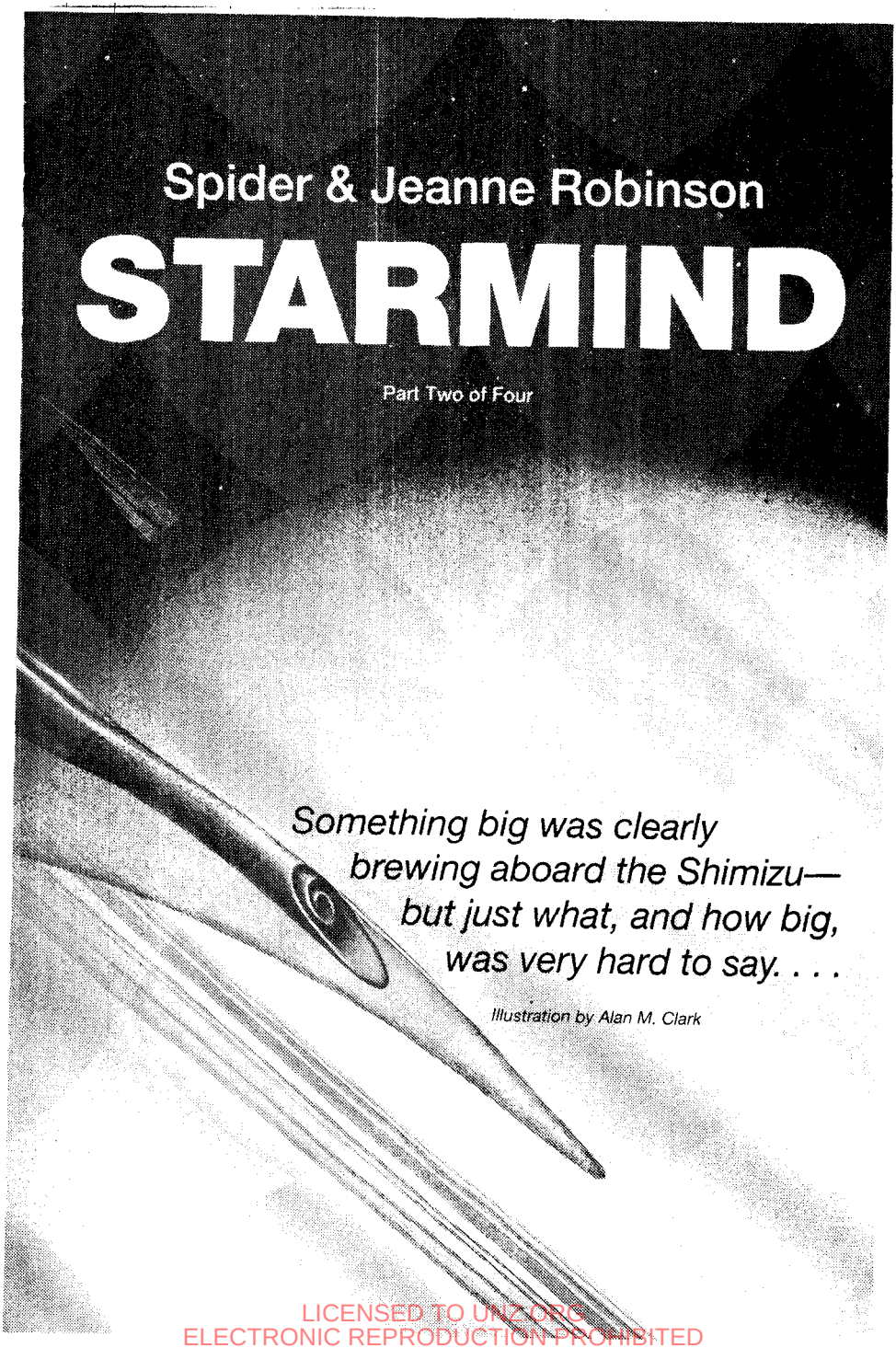
Spider & Jeanne Robinson

STARMIND

Part Two of Four



Something big was clearly brewing aboard the Shimizu—but just what, and how big, was very hard to say. . . .

Illustration by Alan M. Clark

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WHAT HAS GONE BEFORE:

It has been sixty-four years since **Shara Drummond,** *the first zero-gravity dancer, danced her legendary Stardance for the Fireflies (the enigmatic aliens who originally seeded Terra with life: they returned to this solar system in 2001, and left again shortly after). The telepathic group-mind Shara founded in space, the* **Starmind,** *has been growing steadily ever since. It is composed of Stardancers—former humans who have opted to forever renounce the ability to live in a planetary gravity field, in exchange for telepathy and immortality. (Thanks to a Firefly-tailored substance called Symbiote, the complement of the human metabolism, Stardancers live naked in space, untroubled by hunger, thirst, cold, vacuum . . . or loneliness.) Their collective Starmind has been of great service to humanity, assisting in the safe development of vital new technologies—including but not limited to nanotechnology—and helping in the cleansing of the human ecosphere. In return the Starmind asks only for trivial amounts of the trace elements Symbiote does not supply (awkward to harvest for beings who dare not approach any planet closely), and the right to exist. Naturally, humanity's original agreement to this bargain was grudging—but subsequent experience has confirmed that the Starmind has no need for anything that the human race considers an asset. Many humans appreciate Stardancer art and technology . . . but the overwhelming majority, of course, tend to ignore the Starmind's existence.*

As do **Rhea Paixao** *and her husband* **Rand Porter.** *Rhea is a successful writer who has lived nearly all her life in her birthplace, Provincetown, Massachusetts. Indeed, Rand promised her, as a condition of courtship, that he would never ask her to move from her ancestral home—a promise freely given. But now Rand, one of a handful of shapers (composers who also create their own holographic sets), has been offered an irresistible job as Resident Shaper and co-Artistic Director at the most fabulous hotel in space, the Shimizu. In order to work effectively with his co-Director—his own half-brother,* **Jay Sasaki**—*Rand must* live *in the Shimizu.*

And any human who lives in free fall for an extended period will adapt —permanently. *Spacers (humans who live in space) are exiled from Earth as irrevocably as any Stardancer.*

If Rand accepts the job of his dreams he will become, for the first time, as famous as his wife. But if he does, Rhea must choose between her husband and her home . . . for herself, and for their eight-year-old daughter **Colly.**

The conflict being irresolvable, and the need for a decision being pressing, Rhea and Rand agree to stall. He will take the job for a trial period. Perhaps Rhea will learn to like life in space. Perhaps Rand will hate the job. At worst, confronting the antinomy will be postponed until he has settled into the new job.

This expedient creates a problem for Rand's brother. Even though Rand

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is *one of the four best Shapers alive, Jay used every drop of his own clout as Resident Choreographer to get Rand the job. If his beloved kid brother* doesn't *stay, Jay will face the wrath of the Shimizu's manager,* **Katherine Tokugawa**, *and his own job may be in jeopardy. But Jay would rather die than let Rand suspect his selection was even partly influenced by his big brother. Aside from Tokugawa, the only person in the Shimizu who knows the truth is Jay's best friend, a permanent hotel guest named* **Eva Hoffman.**

Jay is the only person in the Shimizu who knows that Eva is planning to end her life soon. At age 116, she is one of the oldest (and wealthiest) residents—and the only one who has ceased to cosmetically control her appearance. Jay is shocked to learn that she wishes to die, baffled by her reasons—something to do with the human race's refusal to either kill itself or straighten up—and terribly moved by the final favor she requests of him: that he dance for her, at her dying. He agrees to do so; and Eva agrees to postpone the event until Rand's situation stabilizes.

Meanwhile, at apparently random locations around Terra, an unknown agency has begun working small, quirky, seemingly pointless miracles. (A chamberpot of urine turns to wine in Australia; a dancer's broken ankle heals itself within seconds in Toronto; and so on.) Most of these pass unnoticed by humanity at large, but soon there have been enough of them for the media to dimly sense that something odd is going on....

CHAPTER 8

Shimizu Hotel
January 7, 2065

Rand became aware that a fragment of his attention was needed somewhere. His wife was present and speaking to him. He played back mental tape and found that she had asked him if he would be free for dinner.

The question confused him. It called for speculation, and contained a word with at least six different meanings. He searched for a proper response, and selected, "Hah?"

She understood perfectly. "Thanks, darling. I'll have Salieri ask you again later. Listen to Salieri, OK? He'll know where we are."

There were so many words, he decided a nod would be safest. It seemed to work: she went away, and though she was frowning slightly she did not slam anything on the way. Relieved, he relaxed and let his eyes and mind go where they needed to. *Damn* Pribhala anyway! Thanks to her, he had been placed in a position where his triumphal first achievement as Resident Shaper would be to wash someone else's garbage. He had been doing so for a month, now, and all he had to show for it was a mountain of wet garbage.

The thing was worse than awful: it was more than half done. Pribhala might not be good, but she was fast. There was no hope of scrapping it altogether and doing something completely new; deadline wouldn't allow it.

Ah well—the ones he should feel

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sorry for were Jay and the dancers of his company. They had already wasted hours and gallons of sweat trying to make this dopey idea work . . . and were committed to performing the results in public, unarmed. All he had to—

She didn't say "I love you" before she left.

He was going to give that some serious thought—but just then it came to him in a clap of thunder how something might be salvaged from this fiasco. Steal from that weird dream he'd had last night: scrap the fakey underwater visuals completely . . . and substitute midair. Instead of sea-bed, substitute a city-sized carpet of clouds, backlit. Individual clouds could billow and move *almost* the same way the stupid seaweed did, the way the dancers needed it to for the choreography to work. From time to time, clouds could part to reveal the ground far below. Sure, it had been done before—but not lately, and not by him. God damn, that might just make the nut. But could he get away with it? What about the abominable shark in the second movement? Substitute a roc, perhaps? No, screw the details—what did it do to the overall *feel?* Did the dance still work with the music?

Well, hell, just about anything worked with that twelve-tone noise. Or didn't, if you asked him. No, it felt feasible. The essential artistic *wrongness* of dancers moving normally while supposedly deep underwater vanished now. If he had to, he'd write all new music to match the dance—he could almost hear it now, in fact; he certainly knew the choreography well enough. "Jay! *I got it!*"

It took a while to establish communication; Jay was in work-mode himself. But eventually they had recognized each other and agreed on a common language, and Rand floated his concept. Jay liked it—said, in fact, that he had had a vaguely similar dream himself only the week before. He sank a few experimental harpoons into the idea before he would get excited, but when it continued to hold air he became nearly as elated as Rand.

But not quite. There is a special pleasure in solving a difficult puzzle that has baffled your big brother. Jay had always been thirteen years older, stronger, smarter, and more successful. Rand did not resent him, exactly: he had always been kind, supportive and generous with his time and attention. That they had had a childhood relationship at all had been primarily Jay's doing; he'd seemed to really enjoy having a brother to teach things to. He had doubtless influenced Rand's career choice, and had never (Rand was sure) insulted him by using his own artistic clout to pull strings on Rand's behalf. And they were as easy in each others' company as brothers were supposed to be; the difference in their ages had not been relevant for decades.

And still, it was always pleasurable to pleasantly surprise the man.

Jay handed the group off to Francine, his dance captain and assistant choreographer, and took Rand to his own suite. Along the way they tossed the new concept back and forth like

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an intellectual medicine ball, firming it up considerably in the process.

"One thing that helps a lot," Rand said as the door sealed behind them. "This crew is really good."

Jay nodded enthusiastically. "Best of the two. They actually enjoy the pony shows as much as the art." Shimizu offered two streams of dance entertainment to its guests: the high art on which Rand and Jay were collaborating, performed in the Nova Dance Theatre, and the "pony show" —essentially cabaret dance adapted for free-fall, sophisticated T&A— performed in the Dionysian Room. "I think of the two assistant ADs, Francine is the one who'll take over my job when I retire. The team you worked with last time are good too—but this team are the originals. It's not just more hours logged: about a year ago something clicked and they meshed." He tossed Rand a bulb of cola, got a root beer for himself.

"That must be rare," Rand said.

"About like the odds of any twelve people in the same occupation falling in love and making it work."

The analogy, with its reminder of the collapse of Jay's relationship with Ethan, made Rand's good cheer begin to evaporate. Work had driven the crisis in his own marriage clear out of his mind—as he had hoped. Jay must have seen something in his face, because his next words were, "So how are things going with Rhea?"

"Honest to God, I don't know what to tell you, bro. She's adjusted to free-fall now, and she seems to like it here OK—but it's going to take more than that. All I can do is cross my fingers and pray that she falls head over heels in love with the place before the next month is up. Because if she doesn't, I'm screwed."

"It happens," Jay said sadly. "Happened to me: *I'm* in love with this dump. It sort of creeps up on you. Don't—"

"You weren't born in Provincetown." But he knew Jay was trying to cheer him up, and did his best. "That kid you picked to show her and Colly around *is* a good salesman, though."

Jay grinned. "If you're not careful, she'll fall head over heels in love with *him*. I'm kidding! As a matter of fact, I have it on good authority that he's, well . . . at least bi."

"That was my guess. Uh . . . just how good is your authority?"

"Don't be silly. A twenty-year-old? I'm old enough to be his . . . his—"

"—Best lover yet. Come on, what have you got to lose?"

"A lot. You obviously haven't tried to keep up with a twenty-year-old lately. Anyway, I like 'em with muscles. We're wandering. Look, what I started to say was, don't change that diaper until you smell it. I know how much that house means to Rhea, and I know Provincetown is the most amazing place on Earth. But this is the most amazing place in space. Give her time."

"Well, I've got a surprise I've been working on for her in my spare time; I plan to spring it on her soon. Maybe tonight. It might just—"

"Phone, Jay," Diaghilev said. "Eva Hoffman, urgent."

Jay's face changed. "Oh, shit. Ex-

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cuse me, bro. Sergei, give me privacy." Tugbots brought him earphones, hushmike, and a monitor screen. He tossed Rand his holo remote and took the call. Rand passed the time by not-quite-watching flatscreen music videos from the Old Millennium, with the sound off, trolling for images to swipe.

He killed the screen when he heard Jay say "Jesus Christ."

"Something wrong?"

His brother looked stricken. "One of my closest friends just decided not to die after all."

Rand looked at him. "Yeah, that'd be hard to take," he said solemnly.

Jay grinned, then frowned, then emitted a short burst of nervous laughter. "God, that sounds dumb, doesn't it?" He shook his head. "Maybe I've got the same problem she has. I just don't know how to deal with good news."

"Who are we talking about? Or should I ask?"

"Eva Hoffman."

Rand was shocked. "*She* was thinking of catching a cab? I always figured her for an honored guest at the Party At The End Of The Universe. I'm glad she changed her mind. I like her a lot."

"Me too. She'll be at the special, tomorrow night."

"What special?"

The company was presently performing *Spatial Delivery*, the piece he and Jay had co-created during his earlier residency; it would be played three nights a week and Sunday matinees until the new piece replaced it a month from now. But this was the first Rand had heard of a special performance.

"Oh shit, I haven't told you yet? Sorry; too many things on my mind. We're doing a command performance. A private concert. In the same theater, of course, but the rest of the goats get told the show is canceled. Only uips and a handful of peasant vips admitted."

" 'Whips'?"

"Spelled *U*-I-P. Ultimately Important People."

Rand prepared himself not to be impressed. "Like who?"

"Chen Ling Ho. Imaro Amin. Grijk Krugnk. Chatur Birla. And Victoria Hathaway. The Fat Five, I call 'em."

It was hard to get air. "All of them? In the same room at the same time? They're gonna see my—our—piece?"

"Yep. Kate Tokugawa's been working on this visit for a month, in secret, and she wants all the trimmings. She authorized me to tell *you*, of course, but I plain forgot."

"What the hell are five of the most powerful people on Earth all doing here at the same time?"

Jay shook his head. "My guess is, historians will just be getting really involved in arguing about that forty years from now. Probably no one will ever know. Those folks can edit reality. And they do not like people knowing what they're doing. Especially before they've done it. Make damn sure you tell Rhea and Colly not to tell anyone about the special until all five are dirtside again."

"Tell two women not to talk about the most exciting thing that's happened to them in weeks? Yeah, that'll

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work."

Jay grabbed him by the upper arm. "Listen to me. This is serious. If the presence of those five guests becomes public knowledge, while they're still here, you and I could both become unemployed real fast. If not worse. People have accidents in space."

Rand shook his arm free. "And an ordinary hotel guest like Eva Hoffman is invited to this top secret performance?"

"Oh Christ, Rand, Eva isn't any ordinary guest, you know that. Eva is Eva. Even Kate is afraid of her. As a matter of fact, I think Eva's going to be there as a guest of Chen Ling Ho. Her and Reb Hawkins-roshi. Look, just trust me on this, OK? Tell Rhea and Colly not to discuss this, even with Duncan. After the Fat Five have left, they can brag all they want; by then security won't matter any more. Between you and me, I suspect the news will be all over Shimizu within five minutes after they dock—but I do not want any leaks traceable to *us*. I like this job. And I'd like to get back to it, OK?"

"OK. I'll tell them. Boot up Terpsichore and let's see how the new idea is going to work."

While Jay brought up the holographic choreography software, a collateral descendant of the original twentieth century Lifeforms program, and set up the parameters of Pribhala's wretched piece, Rand checked in with his AI servant.

"How'm I doing, Salieri?"

"Rhea and Colly are expecting you for dinner at 19 o'clock in the Hall of Lucullus, but they will understand if you are late. I will remind you at 18:45. If you elect to keep working I will inform them, and remind you to stop work and eat at 21 o'clock, using extreme measures if necessary."

"Excellent. Whenever I go home, remind me about that new window program just before I get to the door. Dismissed. Let me at that interface, Jay—see how you like this. . . . "

Extreme measures proved necessary. By the time he got back to his suite, Colly was fast asleep, dreaming of angelfish making puffballs.

He was eager to show Rhea the surprise he had prepared. But she had a surprise of her own to show him first. "I was checking on . . . oh hell, what I was doing was snooping," she said gleefully, tapping a keyboard. The file she wanted displayed on the nearest wall. "And I found this in Colly's partition." It was a text document. At first he took it for one of Rhea's manuscripts, since it had been created with the same arcane, obsolete word-processing software she used. But then he saw the slug at the top of the file: 'The Amazing Adventure,' by Colly Porter."

"It's a short story," she said, her delight obvious. "About a little girl who goes to space, and defeats pirates."

He grinned. "Oh, that's wonderful. And she didn't say anything to you about it?"

"Not a hint. Wait, let me show you the best part." She scrolled the document a page or two, found the place she wanted, and highlighted a portion

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of the text. It read: "But the truth was far from reality."

His bark of laughter triggered hers, and then they tried to shush each other for fear of waking Colly, and broke up all over again. The sequence ended with them in a hug, looking at the screen together in fond appreciation. "Is it any good?" he asked.

"Hard to tell; she hasn't finished it yet. But so far . . . for an eight-year-old . . . it's terrific."

"How long has she been working on it?"

She punched keys. "File created three days ago."

He was impressed. "And she's got, what, eight pages down? Jesus, that's amazing."

She nodded vigorously. "Damn right. Eight pages in three or four days is good output for *me*." She frowned. "Could we have raised one of those freaks who actually enjoys writing?"

He gave a theatrical shudder. "Could have been worse. At least it isn't heroin."

"That'd be cheaper. Ah well, she'll grow out of it. At her age I wanted to be a gymnast."

"Sure, I know. But it's still cute as hell. And you should still be flattered."

She hugged him closer and nuzzled his ear. "You watch: in another year or two, she'll be shaping. I'll go snooping through her files, and a monster will appear and bite me on the ass."

"And it'll serve you right," he said, nuzzling back. "Snooping. Despicable. You haven't been snooping in my partition, have you?"

She snorted. "As if I could outhack you. Why, is there anything interesting in there?"

He smiled. "Never accuse your husband of having a boring diary. Salieri!"

"Yes, Maestro?"

"Run file 'Home.' "

"Yes, sir."

"Take a look out the window, love." He pulled his head back slightly so he could watch her reaction. He was really proud of this idea, and had high hopes for it. He had set himself the question: *My wife is suffering, and it's my fault. What can a person of my special talents do about that?* This was the answer he had come up with after days of thought. Because it was just a first draft, the visual image took a few seconds to coalesce and firm up, pixel by pixel. But somehow he got the impression she guessed what it was nearly at once, the moment she heard the soundscape. She stiffened in his arms.

Outside the window were Cape Cod Bay and Provincetown. The view from Rhea's upstairs turret writing-room window, back home. Bay to the left, stone dike sticking its tongue out at the horizon; P-town in the center, the Heritage Museum's spire rising above the jumble of rooftops; and off to the right, the Pilgrim Monument. It was early evening there; a crescent Moon was just rising over the water.

"That's not a simulation," he said quickly. "It's live, and realtime. Well, three-second switching delay." Somewhere a dog yapped. "See? That's the

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Codinha's rotten little Peke."

Something told him to shut up now. He studied her face. It was as though a gifted actress had been asked to do the audition of her lifetime in fifteen seconds. Every expression of which her features were capable passed across it in rapid succession. The only sounds were distant waves, winter winds, a few gulls, a passing car with a bad gyro and, over all, the sound of Rhea's deep breathing.

And when she finally settled on a reaction—silent, bitter tears—he only got to see it for a second before it left the suite at high speed.

Nice work. He breathed deeply himself for a minute. Then he jaunted to the window and gazed hard at Provincetown for a measureless time. Finally he shut down the display. "Salieri, let me speak to Rhea."

"She is not accepting calls, sir."

"Where is she?"

"Privacy seal, sir."

He nodded. He knew a couple of ways around that . . . but he decided he had already done enough stupid things for one day. If Rhea had wanted him to find her, she wouldn't have taken the trouble to invoke privacy seal.

He was too tired to deal with this much misery, and could not diminish or share it, so he took his work to bed with him, and fell asleep on the back of a cloud, winds whistling past his ears.

CHAPTER 9

The Ring

Saturn

The Stardancer was unplugged from the Starmind, thinking only with her own brain. The vast System-wide flow of telepathic information from the millions of Stardancers who made up the Starmind passed through her. But she did not pay any conscious attention to it, and sent nothing back out into the matrix.

A year ago, something she still did not fully understand had told her that she needed to be still and meditate. She had been engaged in the form of meditation that worked best for her—dancing—continuously ever since. This sort of unplugging was not unusual; at any given time, as many as several thousand Stardancers might be out of rapport, dropping in or out of the matrix as suited them, and as they could be spared from ongoing tasks. Having accepted the alien gift of Symbiosis, they were all untroubled by the need to eat, drink or sleep, and were impervious to fatigue. Furthermore they were effectively immortal, or at least *very* long-lived, which tended to produce a meditative state of mind.

To an observer unfamiliar with Symbiosis, she might have seemed to resemble a human being in an old-fashioned, bulky red pressure suit —without air tanks or thrusters or transparent hood. But she was not human, any more, and the red covering was literally a part of her: the organic Symbiote with which she had merged forty-four years earlier. Designed by the enigmatic alien Fireflies to be the perfect complement to the human metabolism, Symbiote protected against cold and vacuum, turned

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waste products into fuel, could be spun out at will into an effective solar sail . . . and conferred telepathy with all others in Symbiosis.

It also required sunlight, of course, like all living things. She was now, orbiting Saturn, almost as far as she could get from Sol without artificial life-support in the form of a photon source. But she did not feel cold . . . any more than she had felt hot when, decades earlier, she had traveled to the other extreme end of her range, the orbit of Mercury.

She had selected an orbit high enough above Saturn's mighty ring to free her from concerns about navigational safety in that endless river of rock. Her visual field was perhaps the most beautiful the Solar System had to offer, so beautiful that she had almost ceased to see it. And even her harshest critic—herself—could not have said that her presence there detracted from the view, for she had been a gifted dancer even before she had entered Symbiosis. A tape of the past year's dancing would have fetched a high price on Earth. But this was hers and hers alone. As her body flung itself energetically through the near-vacuum, her mind was utterly still; she had long since reached that much-sought state in which one is not even thinking about not thinking. She was pure awareness, fully present yet leaving no trace.

Since she had once been a human being, there was a very primitive part of her mind which was never still for long, and in that part something like daydreaming took place from time to time. From time to time it reached out across the immensity that engulfed her and touched the similar places in the minds of her most beloved ones, as if to reassure itself that they still existed and that all was well with them. As it went down the list, brushing against each mind, her dance unconsciously changed so as to express them and her relationship with them. Thus a sort of occasionally recurring series of motifs ran through the dance: a kind of kinetic giggle that was her youngest child Gemma, followed by the syncopated, slightly off-rhythm movements that represented Olney Dvorak, the Stardancer she had conceived Gemma with . . . and so on, down to her eldest, forty-three-year-old Lashi, and his human father—

—It was at that point that her back spasmed and she screamed.

Any telepathic scream is strident and shocking enough; when it comes from one who has been in deep meditation for a year, every Stardancer in the Solar System flinches. And comes running to see what is wrong and what must be done about it. At once, the Starmind enfolded her like a womb, probing gently to learn the nature of her hurt.

But even she did not know.

The only clue was the word she had screamed: the name of her first co-parent. *I just touched him,* she told the others, *and suddenly I knew something is wrong. Everything is wrong.*

He was in the hookup, of course, and as baffled as she was. He reported that as far as he knew, nothing specific was wrong. He was in a region of great potential danger, but he had

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been there for a half a century now. He was presently engaged in a delicate and complex task, with elements of almost inconceivable danger in it, but as far as he could tell it was shaping correctly.

Since there was absolutely no explanation for her terror, she could not shake it off. Unreasonable fears are the hardest to conquer. She wanted to scan and analyze every second of his memories of the last several weeks at least, looking for clues to the danger, but since he was not a full-fledged Stardancer she could not probe as deeply as she wanted. Their son Lashi joined her, and they probed together.

The results were still ambiguous.

So Lashi turned his attention to his mother. *When did you first become aware that something was wrong?*

When I screamed.

But how long before *that could something have gone wrong? When was the last time you had monitored Father?*

She thought about it. *Yesterday, I think. And everything was fine then.*

And we know what has changed in the last twenty-four hours. So we know where the danger lies.

Lashi's father said, *But why are they any more dangerous to me today than they were yesterday?*

I don't care, she wanted to say. *Can't you get out of there?* But she could not ask that, because she already knew the answer.

I don't know, she said instead. *But dammit, you be careful!*

You know I will, Rain, he replied.

* * *

CHAPTER 10

Shimizu Hotel
January 7, 2065

By the time Jay and his brother had finished a room-service dinner and separated for the night, it was 21:45. Jay tried to call Eva, but her phone was not even accepting messages. He and Rand had accomplished so much work that he decided to celebrate. He jaunted to Jake's, in the Deluxe Tier, one of the livelier of Shimizu's twenty-one taverns—and one of only three in which off-duty employees were welcome. There he found some friends, and settled down to matching orbits with them.

He liked Jake's; he had become a semiregular there since Ethan left him for an earthworm. The management frowned on spilled blood or broken bones, but was tolerant of merriment short of that point. It was a great place to hear extravagant lies. One red-faced old man, for instance, a wildcat asteroid miner named Wang Bin who had come to the Shimizu to drink up a lucky strike, insisted on telling the whole room about a "white Stardancer" he claimed to have seen on his last trip out. "Damn near ran into him, no beacon or anything, spotted him by eyeball. Just like any other Stardancer, but white as a slug. Didn't even have the manners to acknowledge my hail." And a groundhog dancer from Terra who had joined Jay's table told them all a whopper about a broken ankle that had healed itself just in time for a curtain.

The dancer was attractive, close enough to his age and well built—but

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as Jay thought about making an approach, he realized he still wasn't ready. The memory of Ethan was still too clear. A few abortive experiments had reconfirmed for him that casual sex is best with oneself—certainly simpler.

A sense of duty made Jay leave sooner than he wanted to. As soon as he got back to his room, he tried Eva again. Considering the late hour, he did not expect to reach her; he hoped to leave a message requesting an appointment for a chat tomorrow. But the face that appeared onscreen was not Jeeves. Instead he saw a bald and beardless man who had done nothing to disguise the fact that he was well over ninety years old, dressed in black loose-fitting tunic and trousers.

"Hi, Reb," Jay said after a moment of surprise. "I heard you were coming over. How are things in Top Step?"

Reb Hawkins bent forward in the Buddhist *gassho* bow, then smiled warmly. "Hello, Jay. It's good to see you again. Things are well in Top Step, I'm happy to say. How is it with you these days?"

It had been a long day; Jay was too tired for tact. "To be honest, Reb, I'm consumed with curiosity. Is Eva still up?"

"She's gone to bed, but she told me to expect your call. Why don't you come over for a cup? We haven't talked in a while. Or are you too tired? I know you've been working hard on the new piece."

Jay was torn. His brain hurt. But he did want to know why his old friend had decided not to die after all, and it was not the sort of question that could be dealt with over the phone. "I'm on my way."

Hawkins-roshi was something of a legend in space. He was a Zen Buddhist monk, and the oldest continuous resident of Top Step, the Earth-orbiting asteroid where human beings came to enter Symbiosis. For over forty years, until his retirement, he had helped hundreds of thousands of postulants make that profound transition, from *Homo sapiens* to *Homo caelestis*, with minimal psychological and spiritual trauma. A cronkite had once referred to him as the Modest Midwife to the Starmind. During those four decades, he had also made regular visits to most of the other human habitations in High Earth Orbit, including the Shimizu, dispensing spiritual sustenance and friendship to Buddhists and nonBuddhists alike. He and Eva were old and close friends, had known each other since they'd been groundhogs. Jay had met Reb through her.

Almost the moment Eva's door dilated behind Jay, he was glad he had come. He had forgotten how soothing Reb's presence could be. It was not merely his obvious years; Jay was pretty sure Reb had had the same effect on people when he was a teenager. He simply had an almost tangible aura around him, projected a zone of serenity, of clarity, of acceptance. There is a quality dancers call "presence," and Jay was very good at achieving it onstage. Therefore he knew how amazing it was for Reb to have it all the time, every day. Presumably Hawkins-roshi had an automatic pilot, like everybody else

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. . . but he never seemed to use it. He would surely have long since been abbot of his own monastery somewhere down on Earth by now, if he had not found a career more important to him in space: helping human beings become something more.

"How long are you here for?" Jay asked him. "Can that big rock get along without you?"

Reb smiled. "Top Step can get along just fine without me. I'm retired, remember? It's Meiya's headache these days. I'll be here for a week, or until Eva throws me out, whichever comes first. I can use the vacation."

"I'm glad. I'd like to have a long talk with you sometime."

Reb nodded. "But not tonight. You're exhausted. You don't want any tea, do you? I'll make this as quick as I can. You want to know why Eva has changed her mind."

Jay nodded gratefully. "She told you she'd confided in me, then."

Reb nodded. "We talked for a long time. About suffering, and what it is for. About friendship, and what that is for. About what she has done since she came here to space, and what she might do yet. About samsara. In the end I was able to persuade her that to end one's life when one is not in mortal pain or fear is a kind of arrogance."

Jay stared. He had said much the same thing to Eva, in one form or another, at least a dozen times in the last month. "But Eva *is* arrogant," he blurted out.

Reb said nothing.

It came to Jay that perhaps Reb was just better than he was at teaching people about arrogance. Come to think of it, he was doing it now. . . .

"Well," Jay said lamely, "that's great, then. I'm glad you managed to get through to her. But I still don't see how you—"

"How do you *feel* about Eva's new decision?" Reb interrupted quietly. "If you don't mind my asking."

One of the problems with talking with holy men was their uncanny habit of putting a finger—gently, nonthreateningly—right on your sore spots. Another was the difficulty of successfully bullshitting them. "Ambivalent," he admitted.

Reb nodded. "I can see why. What a mix of emotions you must have felt, when she asked you to dance at her dying."

Jay nodded vigorous agreement. "Oh God, yes! Sad, of course, but also proud to have been asked, and annoyed at the extra workload, and creatively stimulated, and . . . and Reb, I'm almost as confused right now. I'm glad we're not going to lose her. But I've just gone through a month of trauma and grief reconciling myself to the idea that we were . . . and I've wasted hours of work on a piece that now may never get performed, at a time when I was already up to my ass in alligators . . . and. . . ."

"And?"

"And if you want to know the truth, a part of me resents the hell out of *you,* for accomplishing in one conversation what I've failed to do in a month of trying. I mean, I know this is your line of work—but she and I have been friends a long time. Part of

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me wants to kick you—and then go wake her up and punch her in the nose."

Reb grinned. "You're welcome to kick me. But if you feel you must wake Eva, make sure your insurance is paid up first. Whatever Eva's brain may be thinking at any given moment, her body's survival instincts are strong—and I happen to know she fights dirty."

"Yeah, I know." Jay had once seen a foolish person behave rudely to Eva. He lived.

"Think of it this way. A man tries to split a tough piece of wood with an ax. He strikes again and again, day after day, with no result. Then another man comes along and takes a tentative swing. The wood splits with a loud crack. Did the first man play no part?"

"Well . . . sure, he did. But he's going to feel frustrated as hell."

"So you didn't just want Eva not to die; you wanted the credit for changing her mind. Be content with partial credit, all right?"

Jay laughed ruefully. "You're right. I'm being silly."

"Also known as the human condition. You're tired and high. Go to bed, and in the morning you'll be a much more admirable human being. I'll be impressed, I promise."

Jay laughed out loud. Reb could always jolly him out of a sulk. "You're right. Uh, look, tomorrow's going to be hectic. Could you ask Eva if she can set aside time for a visit with me the day after tomorrow?"

"I'll tell Jeeves."

"Thanks. And could you and I have a talk the day after that?"

"Whenever you like. I'm going to be busy myself tomorrow, but the rest of the week is pretty much open. Diaghilev and Rild can work out a time."

"Good. I'll see you then."

"And I'll see you tomorrow night at the performance," Reb said.

"Oh, right. I should have known you'd be on the comp list."

They exchanged bows, and Jay left. On the way home his thoughts were so scattered that he let Diaghilev navigate for him. Eva's sudden flipflop just seemed so weird, so . . . arbitrary. Rhea would have said that it didn't ring true artistically. *Eva spends sixteen years making up her mind, withstands a month of argument from me, and then Reb shows up and tells her suicide isn't nice, and she folds?* There had to be more to it than that. What else had Reb said to her? All Jay could think of to do was to ask her at his first opportunity.

As he jaunted along, he remembered some of Reb's closing words. "Diaghilev and Rild can work out a time." Jay was struck by that now. Reb met thousands of people a year, juggled trillions of details . . . and had remembered the name of Jay's AI without checking. He himself had forgotten that Reb called his own AI "Rild"—and had never gotten around to following up his original mental note to find out what that name signified. Whereas he was willing to bet that Reb knew not only who Sergei Diaghilev had been, but exactly what he symbolized for Jay. Perhaps here was a clue as to why Reb had suc-

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ceeded with Eva where he had failed. Reb retained every detail of what people told him, and followed them up, thought them through. "Sergei," he said suddenly, "who did Reb Hawkins name his AI for?"

"I don't know, Jay. Shall I find out?"

"Please."

"Waiting. . . . The only match I find on file is a character in a twentieth-century novel called *Lord of Light* by Roger Zelazny. Rild was a student of the Buddha, a former assassin who came to surpass his master in enlightenment."

The answer was interesting—but what caught Jay's attention was its first word. It had taken Dhiagilev a startlingly long time—nearly three whole seconds—to tap into the vast memory cores of the Net. It was late at night; most guests and staff were asleep. Someone must be using a hell of a lot of bandwidth and processing power for something.

Of course. The Fat Five were inboard. When Leviathan swims under your boat, the sea swells.

He was essentially asleep before he reached his suite; Diaghilev guided him inside, sealed the door, undressed him, administered hangover preventative, and strapped him into his sleepsack so that he would not wake with the classic free-fall stiff neck. His dreams were full of Stardancers—millions upon countless millions of them, swarming around Terra like moths around a fire, staining the ionosphere red with their numbers.

The next day began with an omen, to which he paid insufficient attention.

"Huh? Whazzit?"

"I'm sorry, Jay," Diaghilev said, "but Evelyn Martin insists on speaking to you at once."

Jay suggested some other things Martin could do instead; Diaghilev pointed out that they were physically impossible. "Not for him they aren't. All right, all right: audio only, accept. What the fuck do you want?"

"You're not archiving tonight, right?" Martin's nasal voice demanded.

"Oh, for Christ's sake." From time to time, especially if he had made any alterations in the choreography, Jay would have a concert recorded for archival purposes—and some of the camera angles would include the faces of the audience. Martin was afraid he might do so tonight, with the Fat Five in the house. As a matter of fact, he had been planning to. "Of course not. Anyway, what's the difference? By the time the tapes are edited, the uips will be long gone, and the fact that they've been here won't be secret any more."

"Doesn't matter," Martin said. "Just promise me the cameras stay off tonight. If you want to swear it on your mother's grave, I won't mind."

"Do you have any idea what time it is?"

"I don't give a shit. I been up all night, swimming in a river of shit upside down, and the tide's still coming in: they come aboard in a couple of hours. I feel like that little Dutch kid that used to go around sticking his finger in lesbians; if it ain't one thing

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it's six others. On top of everything else I had a guest croak on me a couple of hours ago, like I got nothing else to do—"

"A guest died?" That was unusual. The Shimizu had diagnostics and emergency medical facilities as good as anything on Terra; it would take something like an exploding bullet to the brain to defeat them. The saying was, *you couldn't die here if you tried.* "How did he manage that?"

"Genius. Apparently he built the comm gear in his p-suit himself. So he's outside taking a stroll, and he goes to put in a call to his heap, up at the dock. Only his homemade antenna slips out of alignment when his homemade power supply blows up, so he microwaves his frontal lobe instead. So now I got to grease all the news weasels to forget to file the story, and rummage through the antheap down there to find his dirtbag relatives and grease *them*—"

Jay did not want to hear about french-fried brains and PR men's problems before coffee. "Who was he?" he interrupted. "Anybody I'd know?"

"Nah—just checked in yesterday. Some old rock rat who struck it rich, and decided to spend his fortune and the last minutes of his life making mine miserable. Why the hell couldn't the inconsiderate bastard have poached his brains out there in the Belt somewhere, where it wouldn't have been my problem?"

Alcoholic memory stirred. "Wait a minute. Chinese guy? Wang something?"

"How the hell did you know?" Martin sounded suspicious.

"I ran into him at Jake's last night. He was telling us all some yarn about a white Stardancer."

"Jesus Christ—keep that quiet, will you? It's gonna be hard enough sitting on this, and those bastards love anything with a Stardancer hook, gives 'em great visuals to cut to. 'White Stardancer,' my ass—the old fart's probably been sautéeing his cerebrum for weeks now, and only just finished the job this morning. Hey, that's it—if he was already brain-damaged when he got here, we got no liability at all—"

This triggered Jay's gag reflex. "I'll keep the cameras off tonight, Ev," he said, and cut the connection. Getting back to sleep was out of the question now, so he called for coffee, unstrapped himself from his sleepsack, and began his day.

Twelve extremely hectic hours later, he met Rand and his family at their suite and journeyed with them to the Nova Dance Theatre. All were dressed in their finest, and the adults were as nervous as if they were about to go onstage themselves. They chattered along the way, and fiddled with their seams and fastenings, and inspected each other for unseen flaws in costume or makeup. Only Colly seemed to take it all in stride; money and power did not impress her, since she did not use the former and had all she presently wanted of the latter.

They had to pass a checkpoint to reach the foyer, manned by six very serious-looking guards, each wearing different-colored armbands. No

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weapons were visible, but it was clear that they were available. Jay noticed with amusement that the guards seemed to watch each other as carefully and constantly as they did the civilians. Five private security forces, plus the Shimizu security, and none of them trusted any of the others.

And indeed, when they had passed thumbprint and retina checks and entered the foyer, Nika, the tech director, approached them before Jay could even begin trying to spot the uips. "Boss," she said, "how the hell am I supposed to call the show with a six-pack of gorillas looking over my shoulder, frowning every time I touch something?"

"Jesus," Jay muttered. "They're even back in the tech hole?"

"They seem to think it's their fucking command center," she said bitterly. "And there's more six-packs at every entrance and exit to this area, plus one at each stage wing. I don't care about them, as long as none of the dancers crash into them when they exit, but can't you get me a little elbow room in the hole?"

Jay thought about it. "I don't think so, Nika. They're right: that area has to be secured. If I were an assassin, backstage is the way I'd come in. Do the best you can, OK? At least Rand and I won't be in there with all of you; we're watching this one from the house. Just tell the goons not to touch anything while the concert's running."

"None of them would dare. The other five would shoot him. They get nervous every time *I* touch a control. Honest to God, I never saw such a paranoid bunch in my life."

"If you needed bodyguards, wouldn't you want them to be paranoid? I have to go—"

Nika jaunted off, muttering, and Jay caught up with Rand and his family. They were just being presented to the honored guests by Katherine Tokugawa.

"Mr. Imaro Amin . . . Pandit Chatur Birla . . . Honorable Chen Ling Ho . . . Ms. Victoria Hathaway . . . Citizen Grijk Krugnk . . . please permit me to present the Shimizu's co-Artistic Directors: our Resident Choreographer, Mr. Jay Sasaki, and our Resident Shaper, Rand Porter." All bowed. Jay was amused again. Kate had solved an impossible protocol problem in the only way she could—by introducing the five uips to her vips in alphabetical order.

"We bid you welcome to Nova Dance Theatre, lady and gentlemen," Rand said smoothly. "It gives me great pride to present my wife, the author Rhea Paixao, and our daughter, Colly."

More bows all around. "I read your last book, *And Call Her Blessed*, with great pleasure, Ms. Paixao," Birla said.

"So did I," Hathaway said, "and it was wonderful. Even better than *The Free Lunch*."

"I would have to agree," Birla said, "although it is a close call. I have conversations with characters of yours all the time."

Rhea thanked them, turning a fetching shade of pink. The compliments had to be genuine: the uips had not expected to meet her, and had no reason to stroke her if they had. Jay

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was stunned to learn that people as rich as this read fiction for pleasure—two of them, anyway. And while Rhea had a good and growing literary reputation, she had never yet had a top ten bestseller: you had to *care* about good books to know of her work. Interesting. Uips were not automatically philistines. Rand caught his eye and grinned, and Jay knew precisely what he was thinking: *If they like Rhea's stuff, they'll like ours.*

While the conversational pleasantries flowed back and forth, Jay studied these five people who could make Kate Tokugawa snap to attention. He had never met a whole handful of trillionaires before.

Amin was a Kikuyu financier from Kenya, said to be the only African trillionaire. Of average height and mass, he was in his early forties and looked thirty, except for his eyes; he was the most obviously vicious of the five. His hair was straightened, but paradoxically his skin tone was artificially *darkened,* to a Bantu black which did not match his nose and cheek structure. His fortune was based on Earth-to-orbit shipping. He ignored the arbitrary local vertical which everyone else had adopted—the Terrans from habit, the spacers out of politeness—and just let himself drift free.

Birla, a swarthy Marwari from Rajputna, was the talker of the group, which made him seem more trivial than he could possibly have been. He was a hundred and twenty—four years older than Eva!—and looked forty. According to the bio Jay had scanned, he was ostensibly a devout Hindu, but he seemed in no hurry at all to reincarnate. The friendly twinkle in his eyes had to be fake, but it was a good fake. He owned as large a proportion of the Terran and orbital media as the U.N. would let him, and influenced even more; Evelyn Martin *hovered near him solicitously, ready* to open a vein on request.

Chen Ling Ho, a Mandarin from Beijing, was fifty and looked fifty. He was short to the point of tininess, smaller than Kate, and looked as benign and childlike as Colly. Jay had read that his enemies called him The Krait. He was also the Zen Buddhist at whose request Reb Hawkins had been invited to the Shimizu. That interested Jay: there were many Chinese Buddhists, but few who followed the Soto path, which had originated in twelfth-century Japan. Chen was a grandson of the legendary Chen Ten Li, the twentieth-century statesman who had been present at the creation of the Starmind; heavy (and early) family investment in nanotechnology had made Ten Li rich beyond measure. In defiance of tradition, it had been the *second* generation—his son Chen Hsi Feng—who had nearly succeeded in destroying the family name and fortune, by becoming an antiStardancer fanatic and launching a treacherous and doomed attack on the Starmind. Ling Ho, the third generation, had miraculously managed to salvage most of the wreckage, largely thanks to adroit fence-mending with the Starmind. That doubtless accounted for his conversion to Reb Hawkins's faith. Jay wondered how many trillionaire Zen

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students there were.

Victoria Hathaway was a WASP from New York; calendar age eighty-seven, apparent age just under thirty. She looked like holo stars wished they looked—but there was a coldness in her eyes and mouth that made Jay think of her as a long sleek shiny pair of scissors, with a carefully trimmed little tuft of pubic hair just at the place where the blades joined. Most of her money was said to be in real estate, on and off Terra, and she was famous for both her ruthlessness and her absolute lack of any vestige of a sense of humor—though no one dared mention the latter quality to her face.

Grijk Krugnk was by far the ugliest of the lot, a Slav of some kind from Votoskojek who was sixty-six and looked fiftyish. He was built like a power plant, but not as pretty, so obviously a brute that many had found him fatally easy to underestimate. His wealth sprang from power generation, most of it spaceborne. Oddly, he was the only one of the five whose English was utterly unaccented, like a cronkite's. He handled himself in free-fall as well as Amin, but made less of a point of it. His complexion must have been ruddy on Earth; in zero *g* his face looked like a tomato.

Each of the five had a personal bodyguard, and all but Chen had an additional companion as well. These latter were introduced, but Jay didn't bother to remember any of the names; they were obviously AIs with a pulse. The killers were not introduced, as it might have distracted them. Chen's bodyguard seemed to be the only one with any extensive space experience: Jay noticed that he watched feet as well as hands. That made his boss the smartest of the five uips.

"Is there anything you would like to tell us about the work we are about to see, Mr. Sasaki? Mr. Porter?" Birla asked, snapping Jay out of his reverie. Rand let him take it.

"No, sir," he said. "If it doesn't speak for itself, then nothing I could say will help. Shall we go in?"

Perhaps taking their cue from Tokugawa's introduction, the five uips entered the theater in alphabetical order. Once inside, things got briefly complicated again.

This piece, "Spatial Delivery," had been staged for proscenium performance, rather than in the sphere. That is, it was designed so that the audience used only half of the available "seating" area, strapping their backs to a common hemisphere, and the piece was performed against the backdrop of the other half. This cut audience capacity in half, but was a lot easier to choreograph and shape than a spherical piece which had to look good from all possible angles at once.

But if five people sit against a hemisphere, and keep pretending that there is a local vertical, then some of them must sit "above" others.

After a few seconds of backing and filling, the five decided face was more important than up and down, and solved the problem by making a puffball, like a two-dimensional version of Colly's beloved angelfish. Lesser mortals filled in the gaps between

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them in whatever orientation suited them. Jay sat with Rand and his family in the center. He saw Eva nearby, and waved; she waved back.

The house lights dimmed, Rand's overture began, and Jay forgot anything as trivial as trillionaires.

The first half went very well. Emerging from his warm fog to the realization that he must make small talk during the intermission was like being dumped from a snug bed into icy vacuum.

And indeed it developed that the intermission chatter of uips was every bit as inane and clumsy as that of the mere vips Jay was used to. They all liked it so far, of course, and said so—but for all the wrong reasons, some that Jay would never have thought of in a million years. Intermissions always made Jay wish he had taken up engineering, or any trade where the customer's wishes were possible to fathom. Talking to civilians usually reminded him forcefully that no artist ever succeeds save by dumb luck. Since he believed the purpose of art was to communicate, this tended to depress him slightly.

Five minutes before the end of the interval, he excused himself from the gathering, saying that he needed to check something with his technician backstage. Rand seized the opportunity to accompany him, ignoring his wife's brief look of dismay, and they jaunted back into the empty theater together.

There were four "wings," short cylindrical tunnels of invisibility created by Rand's shaping gear, at the four cardinal points of the terminator that divided audience from stage. Dancers seemed to materialize as they entered, vanish as they exited. Knowing that two of the wings would be blocked by knots of dancers nerving themselves up to go on for the second act, Jay and Rand picked one of the other two at random.

And nearly got themselves shot by trigger-happy guards. "Jesus, folks, relax," Jay said. "There won't even be anybody out there to protect for another five minutes yet. Why don't you safety those damned things until then? I don't want you drilling one of my dancers on their way to the can." Shaking his head, he passed on until he came to the tech hole, which was located at the farthest point of the theater, so that its one-way glass looked out past the dancers toward the audience. In fact, he and Rand had nothing to accomplish here; Nika had this piece on tracks by now. The tech hole was simply the nearest place to hide for a few minutes.

Not wanting to risk being shot *again*, he paused at the door and touched the intercom button. "It's me, Nika," he said. "Coming in."

The door opened on horror.

Six bodies, drifting limp in free-fall crouch. Jack-in-the-box effect made them move toward him as the door swung open. Nika was one of them. A barely perceptible bitter odor preceded them; Jay could not identify it but knew it was trouble. "Oh, *shit*," Rand said behind him.

"Hold your breath," he snapped, and leaped into the hole. The room's air system had already scavenged up

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most of the bitter gas, but who knew how much it took to immobilize a man?

He did not have time to find out if any of the floating bodies were alive; more urgently he needed to know who was missing. Sure enough, the worst possible: the Shimizu's man. His brain raced. The assassin had planned to kill from here, firing through the one-way glass into the house. At Jay's announcement he had bolted out one of the other two doors from the hole—seconds ago. His only move now was to cut through another six-pack somehow, enter the theater through one of the four wings, leave by the audience entrance, and try to kamikaze whoever his intended victim was out in the foyer. But *which wing?* Presumably he knew which two were mobbed with dancers; he had been hanging out in the hole. And if Nika had had her mikes hot... he knew which wing was guarded by a six-pack *who had just been told to safety their weapons.* By Jay! The son of a bitch could have circled around behind them while they were gaping in the open door of the hole....

"Make an announcement," he brayed at Rand, and pointed to Nika's board and mike.

"What do I say?"

"Run for your fucking lives!" He left the hole at full thruster power.

He began deep breathing as he left the hole—can't have too much oxygen in a crisis—but within seconds he held his breath again as he detected more of that bitter smell ahead. The assassin had had a second gas-bomb—and kept it to use where it would do him the most good. As Jay came around the curve he saw the six-pack he had passed moments earlier, drifting with the air-currents. He wanted to decelerate to a stop and peer cautiously into that magic tunnel before entering it—but he was traveling so fast he'd have had to overshoot it and beat back, and he just didn't have the time. Instead he threw himself into a power turn and rocketed right into it at max acceleration.

That probably saved his life. The assassin was still in the tunnel, waiting to scrag Jay the moment his head showed. But Jay arrived like a right hook, smashing solidly into him before he could fire. They recoiled from each other violently, and the assassin lost his grip on his weapon, a hand laser. But there was no gravity to take it away; it kept station with him as he tumbled, and he grabbed it again on the second flailing try.

The assassin was a very good shot. But Jay was a very good dancer—and fortunately the gun was a pulse job rather than a garden-hose-type continuous-beam laser. He twisted, arched, feinted, leaped, contracted, and bolts of shining death missed him by centimeters. He had one further advantage: he could use all four thrusters, while the assassin had to reserve one wrist for aiming. Thank God the man seemed to be out of knockout bombs.

But Jay could not hope to close; it was all he could do to stay alive. And any second his luck must run out. He could leap through the imaginary

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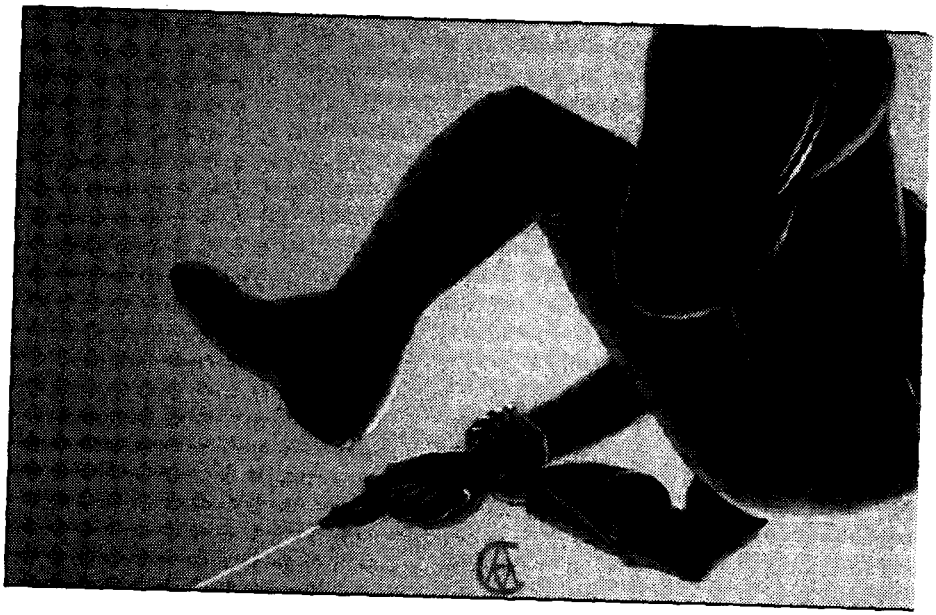

wall of the tunnel, but the killer would only follow. Any minute now the nearest six-pack would arrive behind him, and none of them would hesitate to fire through him even if they identified him as a friendly. Jay had time to realize that he was going to die protecting people he did not like or even respect, and then the tunnel had a blowout. A hole the size of a Frisbee appeared in its wall with an explosive *phuff*, jagged metal teeth pointing outward; the shriek of escaping air tore at their ears and pressure began to drop.

Of course it is impossible for a holographic cylinder to have a blowout, and in any case the nearest vacuum was hundreds of meters away. But both men were spacers; they reacted quite instinctively, dropping their quarrel and leaping for the hole together to seal it with their bodies if necessary. Only one of them remembered on the way that the greatest shaper in human space was presently in the tech hole, and that this tunnel belonged to him.

CHAPTER 11

Eva was the first to enter the tunnel; nearly at once she reversed thrust and recoiled backwards into Reb, who was at her heels. A weapon she was not licensed to possess vanished from her hand. Jay had clearly coped. Even her atrophied sense of smell could detect the odors of burned metal and burned meat.

"Nice work," she said. "Remind me not to piss you off."

Jay's eyes met hers, but it took him

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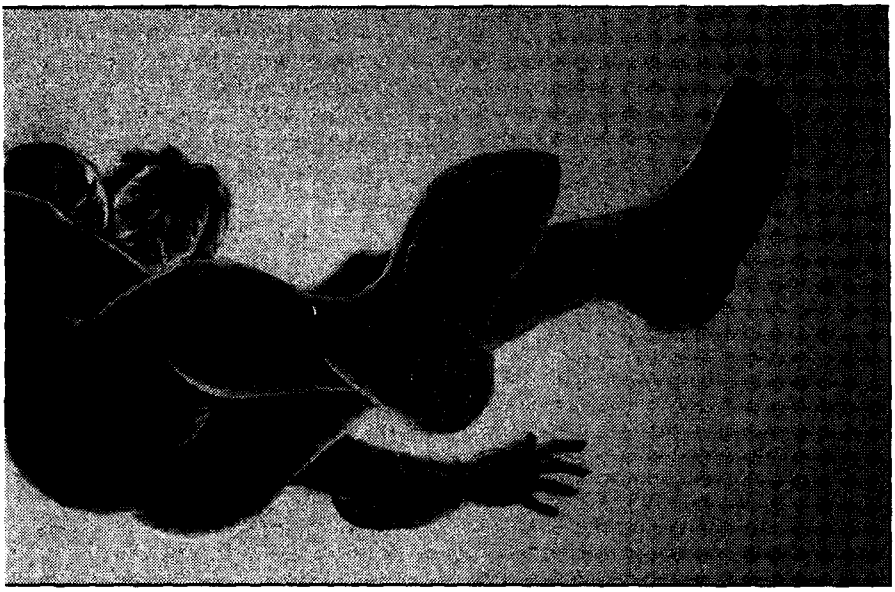

a second or two to recognize her. "I got him," he said wonderingly.

That much was clear. The body that floated between them was so obviously a corpse that Eva's subconscious had ignored the gun it still clutched in one hand. Boiling brains leave a skull any way they can. Jay had a small smear of suet on his right cheek that must have burned him as it struck, but he didn't seem to be aware of it. Eva threaded her way through horrid drifting tendrils of brains and blood and took Jay in her arms. "That you did," she said soothingly, wiping his cheek. "That you did."

Rand arrived just then; at Eva's signal he left Jay to her. She gestured again, and he and Reb took charge of the body, towing it backstage, shooing its gore along with it.

Sure enough, Rhea and Colly were the next to arrive. At the alarm, all five uips had ducked for cover and their guards had clustered around them, and mere vips had struggled to get away from them. Tokugawa and Martin had called for information —but Rhea and Colly had both realized they had family in the firezone. Rhea hadn't been able to stop her daughter, but had gotten—barely —ahead of her to shield her from possible fire. Eva moved so that she and Jay blocked their way. "He's fine," she said quickly. "Wait here for him."

Rhea was frantic. "I've got to—"

"*You've got to wait here*," Eva said, indicating Colly with her eyes.

"I—yes, OK." She got a firm grip on Colly. "He's really all right?"

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"Not a scratch, truly."

"He saved my life," Jay said.

"And others," Eva agreed. "Both of you did. I'm surprised at you, Jay—I thought you had more sense than to be a hero."

"I had to," he said. "It was partly my fault."

She put a hand over his mouth. "He's delirious," she said to Rhea. "All the adrenaline." She turned back to Jay, put her lips to his ear. "As your attorney, I advise you to shut the hell up. You are not competent to assess blame."

He blinked at her. "You're not an attorney, Eva."

"The hell I'm not. I'm licensed for the High Court—and if you don't start zipping your lip I'm going to need to be. When they get here, you tell them facts only, get it? Facts only. You can draw conclusions when you're thinking more clearly. OK?" She shook his shoulders. "OK?"

"Sure, Eva. Facts only. That's good." She studied him carefully, decided he was not quite in shock in the medical sense—but close.

The tunnel went away; Rand must have reached the tech hole. Almost at once they were hip-deep in people, all talking at once. All five uips, assorted assistants and bodyguards, the Shimizu's security chief, the house physician. The loudest by a good margin was Martin. Eva bellowed for silence, but her tired old lungs weren't equal to the task.

Reb's amplified voice filled the theatre like the voice of God. "Ladies and gentlemen, please compose yourselves. There is no longer any reason for alarm. An attempted assassination has failed, and the situation is under control. Please return to the foyer as quickly and quietly as you can; emergency personnel will be arriving and you are in their way. You will all receive a detailed report when things have clarified."

Rand's voice joined him. "Dancers, please join our guests in the foyer and escort them to the reception room. The rest of tonight's concert is canceled."

The tumult of attempted conversation became even louder—but at Martin's physical insistence, they at last began moving away, with Tokugawa in the lead. Rand told Rhea to take Colly back to their suite, and she agreed without argument. Dr. O'Regan and Chief Cruz remained behind.

"Who was it?" Cruz asked.

"One of yours," Eva said. "Dunno which—he didn't have his face with him."

Cruz's face darkened. "I know which. Shit. Where'd they take him, the tech hole?"

"I think so." She turned to Jay. "Can you stand another look at the son of a bitch? Chief Cruz needs you to show her what happened."

"Oh sure," he said.

As they left the tunnel, they had to duck around tumbling bodies and a few severed limbs—but fortunately no more horrid trails of blood, as laser amputation tends to self-cauterize. Eva noticed how hard Cruz had to work to ignore the one in Shimizu livery.

Cruz made them wait briefly out-

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side the tech hole. Two crime-scene technicians and three interns all arrived at once; she and the doctor went inside with them. The security chief emerged with Rand in less than a minute, scowling blackly. The conference took place there in the corridor. Cruz—mortified that one of her own people had been the killer—obviously wanted Eva gone, but did not dare try to chase her out. Eva did not even have to claim status as Jay's attorney of fact; a steely glance was all it took. She and Cruz had taken each other's measure a long time ago.

So she was able to ride herd on Jay. She was fond of the boy, and his raving about the attempted assassination being partly his fault had unsettled her. If Cruz had heard that, the questioning might well have taken place under drugs. At Eva's direction, Jay gave a baldly factual account of what had occurred. She spotted what he had meant as soon as he said it—"I told them to safety their weapons and continued on to the hole."—But of course no one else saw any blame in that. It was what anyone might have said in his place. She was glad she had gotten to him first.

"Pity you couldn't have taken him alive," Cruz said, when Jay had finished the story and Rand had added events from his perspective. "I hate to let someone kill a dozen people in my care without asking him who paid for it."

"I was dead," Jay said, "and then Rand gave me a split-second advantage. I didn't think about it. I grabbed his gun hand and made him shoot himself under the chin. I'd do it again."

"Oh, I wasn't criticizing! *Do* it again, if there's a next time."

Eva snorted at that. If Jay had not gotten lucky, Cruz would have had more dead—and perhaps a dead uip or two as well—and would have been looking for work tomorrow.

"I wish he was still alive, too," Jay said. "So I could kill him again. Nika's . . . Nika was special." Suddenly he shook his head with great violence. "Jesus! Did that really happen?" He giggled.

"You've got everything you need for now, right, Chief?" Eva said.

Cruz frowned, but nodded. "I may want to hypno him tomorrow."

"Gotta wait for it to seep into long-term storage for hypno to do any good," she agreed. "Jeeves—"

"Yes, madam?" He shimmered into existence, urbane and unflappable.

"Take Mr. Sasaki home. My place, not his. Bunk him down in my bed and make me a doss in Guest Room Two."

"Very good, madam. If you would be good enough to follow me, sir. . . . "

"Half a mo." She motioned Jay close and murmured in his ear. "Want Jacques to join you?"

He blinked at her and struggled with the question. Jacques's job description read, 'hedonic technician'—but Eva happened to know that he was more artist than technician, a natural healer and comforter. "No," Jay said, and then "I don't think so," and then he blushed slightly and said, "Uh . . . yes. Please."

She nodded. "Tell Jeeves. Run

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along now."

Once he was gone, she turned back to Cruz. "How did you know who the assassin was?"

"Eh?"

"You said, 'I know who it is.' How did you know?"

"Oh. Savannavong only joined the force a month ago. I wouldn't have used him on this job, for that reason—but Hanh came down sick this afternoon and I was stretched thin."

"Savannavong was real good at making people come down sick," Rand said bitterly. "Hanh got lucky."

"So did you two," Cruz said. "You both reacted like trained cops. Either of you ever in service?"

"I did two years with NYPD. Draftee. But that was over twenty years ago, and I never drew my weapon in the line of duty. Jay's never had any kind of combat training, to my knowledge. We just kept making mistakes until the bastard was dead."

"You'd better get home," Eva said. "Your wife still doesn't know the details."

"Chief?"

"Go ahead."

Rand threw her a grateful glance and made his escape.

People were coming and going from the tech hole now, bringing in forensic equipment and taking out corpses. But they gave the glowering Chief Cruz a wide berth; for the moment Eva was effectively alone with her. "Does your thumb hurt, Chief?" Eva asked suddenly.

"Eh? Yes it does—why? How did you know?"

"Because I figure you for an honest cop. The moment that alarm sounded, an honest cop in your shoes would have pushed a button and flooded the whole damn theatre and backstage area with sleepy gas."

"I did! Some son of a bitch had—"

"I know. It didn't work, so you kept pushing; that's why your thumb hurts."

Cruz nodded slowly. "I see." She thought some more. "Well, it wouldn't have helped anyway: the bastard obviously had nose filters in."

Eva nodded. "Like you do. But you didn't know that at the time. An honest cop couldn't have."

"But why disable the sleepy gas if he had filters?"

"So he'd have maximum confusion to escape in after he made his kill? Squawking civilians in all directions."

"Goddamn it, Eva—"

"Relax, Rani—I'm on your side. I know this whole episode makes you look like a horse's ass, but I can't think of anything you could've done better. And I'll tell Kate Tokugawa that, if you like. But if I were you, I'd have Dr. O'Regan document that thumb sprain."

She left Cruz and went to the reception, curious to see how the ultimately rich responded to a brush with death. Six cronkites ambushed her just outside the door, looking like children who needed to urinate; the first in line named a figure. "No comment," she said. He named a second figure, and when she refused that too, a bidding war developed. She brushed through them grandly and entered the hall. Guards prevented

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them from following; frustrated, they all jaunted off to file what little they already had.

The party had that slightly forced gaiety which screams of fear just past. But the uips themselves seemed the calmest people in the room—except for Reb, of course. In fact, the only person who still showed any overt signs of fear was Evelyn Martin, grinning and sweating and talking even faster than usual. He spotted her, detached himself and came over.

"Hi, Eva," he said loudly. "So glad you could make it." Sotto voce he added, "Anything else gone wrong out there? Any more assassins come to squeeze my ulcers? Fresh stiffs? Other major felonies? Chief Cruz find out the assassin is a High Council member or anything like that?"

"Good news," she said. "No news." Louder, she added. "Awful to see you, Evelyn. You're looking uglier than usual tonight."

He beamed. "Thank you, dear—have you met our honored guests? Chen Ling Ho, for instance?"

"Get a grip, Evelyn. I introduced *you* to Ling. Why don't you go take a trank?"

"I'm at system max now," he said.

"Take stimulants, then. Your voice will rise above the audible range and you won't be so conspicuous." She drifted away and joined her escort, Dr. Chen. He was chatting with Reb and Victoria Hathaway. Chen introduced her to Hathaway—who regarded her aged features with barely concealed horror.

"Hello, dear," Eva said. "It's nice to see you again."

"We've met?" Hathaway said, disbelieving but polite.

"I knew your grandmother. You peed on my lap once."

Hathaway gave the only possible reply: dead silence.

Chen intervened. "Eva, have they determined yet who was the assassin's intended target?"

She shrugged. "For all Cruz can tell at this point, he was a good guy, come to take out Evelyn Martin on behalf of all mankind."

That got a laugh; even Chen almost smiled. "I assume the man's background is being checked?"

Eva shrugged again. "Sure. But it's a waste of time. The background check you have to go through to get hired for Shimizu security can't be improved on. Serious money went into this." She made sure her gaze was not resting on either Chen or Hathaway. "I will bet cash the person who hired it done is in this room."

Hathaway flinched, but Chen only nodded. "The probability is high," he agreed.

"Was it you, Chen?" Hathaway asked bluntly.

Again Chen looked as if he were remembering what it felt like to smile. "Twelve dead, none of them the right one? I'm offended, Victoria. Can you truly believe me so inartistic?"

"Oh, but you can believe it of *me*, right?"

"Since you ask, yes. Now we are both offended. Shall we seek another topic of conversation?"

Eva had a mischievous thought. "Unless you'd like me to narrow the

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list of suspects for you," she said.

"How?" Chen and Hathaway and Reb all asked simultaneously.

"Well, only theoretically. I don't actually expect, uh, people of your caliber to submit to a body search. But I'll bet a dead frog the person who hired that killer is wearing nose filters. He or she knew the killer would be covering his escape with death gas, and might have been forced to flee past his employer. Nose filters that go in far enough to be invisible aren't easily removed."

Hathaway objected. "That wouldn't prove a thing. Any of us might be wearing nose filters out of simple paranoia. In light of events, it would seem an intelligent precaution."

Eva nodded. "But you're probably not *all* filtered. I said 'narrow the list,' not nail it down. Irrelevant anyway; none of you will tolerate a search on principle—and I don't blame you."

"Then why did you bring it up?" Hathaway snapped.

Eva did not answer. But she was already enjoying the mental picture. As the word spread, the five would spend the next hour discreetly trying to peer up each other's nostrils. Victoria Hathaway might actually not look down her nose at anyone for the rest of the night.

Reb escorted her home. They took double-bulbs of Irish coffee to the window, and sat looking out at mother Terra in companionable silence for some time.

"Jeeves," she said then, "is Jay awake?"

"He and Master Jacques are both sound asleep, madam."

"Thank you. Let me know if he wakes." He shimmered away again, and she turned to Reb. "That bedroom is soundproof anyhow."

Reb nodded. "Go ahead."

"I need a better cover story for him. About why I'm still using up air. Oh, you did a good job. But I heard his voice, and he didn't really buy it, deep down. I'm afraid I shot my mouth off to him about why I was planning to take a cab. He's not going to be satisfied with what you told him. And I don't know what else to say. The boy knows me too well. And he spent a whole month trying to change my mind: his pride demands a convincing explanation."

"Not just pride, Eva. He loves you."

"So what do I tell him? I *can't* tell him about—"

"No. I suggest you stall as long as possible. With everything that's happened tonight, he'll be too busy to remember the question for a few days. When he does, you can be unavailable for some additional time. It may be weeks before he has time and opportunity to brace you about it."

"And what then?"

"You tell him I promised you entertaining surprises were still in store for you—and proved it the very next day."

"And if he persists?"

"Let icicles form on your brow and tell him it's personal. A shame to hurt his feelings, of course, but I don't see what else you can do."

She sighed, and sipped her drink. "You're right. I can't tell him."

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"No, you cannot. I should not have told *you,* Eva. But you are my oldest living friend, and I could not see you leave just before everything changed."

She found her eyes stinging, and shut up. They shared more silence for a time.

"Do you think it was Chen?" she asked at last.

"Behind tonight's violence, you mean? I don't know. What do you think?"

"I think an inartistic hit would be a very artistic touch indeed. But it's hard to refute his essential point. If he'd done it, it would have worked, however garishly."

"Apparently it was only by incredible chance that it didn't."

"And I tend to find incredible chance incredible. But I'd bet my life both Jay and Rand are straight." She glanced over her shoulder at the bedroom door. "You know what I mean. They're both honest."

"The gods have blessed us," Reb said cheerfully.

"They have?"

"Of course. How often does life hand you a really good puzzle?"

She blinked, and grinned. "You're right. Not often enough these days. I feel like a sixty-year-old again."

CHAPTER 12

Kechar Dzong
Lo Monthang
The Kingdom of Lo, Nepal
12 January 2065

"There was a time," the old monk said above the howling of the late afternoon wind, "when this kingdom controlled all trade throughout the Himalayas. It was the top of the roof of the world."

Gunter Schmidt thought, *I will not kill my travel agent. That is far too merciful. I will sue him until he bleeds from the eyes.*

"Of course," the old man said with magnificent redundance, "all that was long ago." He underlined the unnecessary words with a sweeping and equally superfluous gesture. Every square inch of the immense fortress-cum-temple within which they stood shouted that the structure had already been a long-abandoned ruin on the day Johann Sebastian Bach died.

From their vantage point on one of its flat rooftops, they could see Lo itself laid out below them in the merciless sunlight of a cloudless January afternoon, a collection of flat-roofed, log-laddered earthen dwellings at the base of the hill on which this crumbling castle of Kechar Dzong stood. Even by Fourth World standards, the Kingdom of Lo was unimpressive. The land was parched, supporting nothing higher than thornbushes; a few carefully nurtured stands of poplar and willow saplings were to be found in the village itself, but wood had been too precious to burn here for centuries. The brief growing season was over, and even the Himalayan vista in the distance could not overcome the bleakness and desolation of the landscape. The kingdom was permitted to exist, semiautonomously with its own king and queen, within the larger kingdom of Nepal—largely because there was nothing here worth arguing over.

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"What happened?" Gunter asked, not because he wanted to know, but because he wanted to hear the old monk say something he didn't know already.

"Calamity. The Kali Gandaki moved."

"I hate when that happens."

The old man actually seemed to catch the irony. "The Kali Gandaki was the river from which the strength of Kechar Dzong flowed. It once passed by right there—" He indicated a vague gully meandering through a section of rocky outcroppings no more or less desolate than any other, a few hundred meters downslope. "But when it changed its location at the end of the sixteenth century. . . . "

Gunter understood now, and his anger deepened. "And ever since, you have been praying for its return—"

"—In the Tiji ceremony, the elaborate and beautiful ritual I told you of earlier, yes," the old monk agreed happily. "Dorje Jono, the son of the demon who moved the river, repels his father with the power of his magical dancing, and brings water back to the land. The Tiji ceremony takes three full days, and involves every member of the kingdom who is well enough to travel. We summon them with the two mountain horns I showed you downstairs, each of them four meters long. For three days Lo becomes the most magical place in the Himalayas, with *damyin* music and feasting and dancing and singing and beautiful costumes and pageantry and—"

"In *May*," Gunter said through his teeth.

His rhapsody interrupted, the old man blinked at the venom in Gunter's tone. "Well, yes, as I said, that is when foreigners usually visit us. We seldom see a European this late in the year."

"Really?" Gunter said, pulling his parka tighter at his throat against the sharp and icy wind. He mentally replayed the conversation with his travel agent, realizing in hindsight that while the man had waxed eloquent about the Tiji festival, he had never specifically said when it was held. He had only seemed to suggest, somehow, that Gunter barely had time to book his passage if he wanted to be there in time. The trip had been quite arduous. The last fifty kilometers had been accomplished on horseback, following a guide with whom Gunter had no languages in common. *So I can't sue the bastard, and killing him is too good for him. Ah, but what about torture?*

From somewhere in the far distance to the north came the half-mournful, half-comic sound of a Tibetan mountain horn like the two Gunter had been shown downstairs, a sustained baritone bleat that had always reminded him of a brontosaur dying in agony. It made the mountains ring with echoes. "What's that?" he asked idly. "Call to prayer? Some sort of religious ceremony in another temple?" Perhaps this trip need not be a total loss. Exotic religions were a hobby of Gunter's; having had his mind set for a grand festive colorful Buddhist ceremony, he was now prepared to settle for the local equivalent of Vespers, rather than go home empty-handed.

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But the old man was shaking his head. "I have no idea."

For some reason, this irritated Gunter. "Well, who lives up that way, then?"

The old man looked sorely puzzled. "Hardly anyone. There is an old hermit who lives in that general direction, and I know he has such a horn, because I have seen it outside his home. But I have never heard him blow it—if indeed that is his horn."

Gunter lost his manners. He had wasted a week and a fortune to see something exotic, and now he was freezing his buns off in a crumbled ruin—an *empty* crumbled ruin—that would be deserted for the next six months, with a canny native guide—clearly one of the oldest inhabitants of the area—who could not even tell him the significance of a simple mountain horn signal. "Perhaps it is Charlie Parker," he snarled, "practicing in secret until the day when Kansas City needs him again!"

He did not expect the monk to get the reference, of course—but the gesture the old man made indicated that he had not even heard the remark. The wind had redoubled in fierceness and volume. "Never mind!" he said, louder, and could not even hear himself this time. Again the monk pantomimed, *Excuse me?* Gunter's temper boiled over; he waved his arms angrily, gave a wordless shout of exasperation, and set off toward Lo, below. He deliberately left the ancient ruin by a different exit than the one by which he and the monk had entered, one which was more difficult to negotiate, and once he had reached the ground he continued at a pace which he knew the old man would be unable to match. He had forgotten how difficult the climb up had been.

Within a few hundred meters, he was breathing hard. It occurred to him suddenly, as he was negotiating a two-meter dropoff, that in his irritation he was about to leave here *competely* empty-handed. He stopped and took his camera from his shirt pocket. At least he could get some good shots of the ruined temple itself. He had purchased enough memory for five straight days of shooting; might as well get a few minutes. He turned and grunted with satisfaction: the decaying temple really did look striking against the sky. It somehow gave Gunter the impression of a fortress built to defend men against the gods. Unsuccessfully. He backed off a few steps for a better angle, and checked the camera's charge. To avoid wasting power, he disabled the audio pickup. The wind was really roaring now, and he could overdub the audio later, with something suitably timeless and melancholy.

He peered through the viewfinder and panned across the face of the ruin, left to right and then back again. He did not see the old monk anywhere, and wondered if he were still within the walls, paralyzed by Gunter's rudeness. Then he did see him—and sure enough, he was standing in the same window they had both been looking out from, minutes earlier. He appeared to be doing jumping jacks.

Gunter grunted in surprise, and

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zoomed in. No, the old man was hopping up and down and flapping his arms, but not in any organized fashion. He seemed to be waving at Gunter. Gunter zoomed in further, and became even more puzzled. The old man appeared to be laughing like a loon. And he was pointing now, pointing to the north. Was he trying to say something about that silly horn blast? In sign language, at this distance? Gunter waved back with his free hand, signing, *forget it.* This seemed to convulse the aged monk; he held his ribs and roared with silent laughter.

Gunter had heard of this: Himalayans were known to go into spontaneous laughing jags, due to the low oxygen at this height. He found it annoying: here he was trying to get an imposing shot of this ancient temple, and its caretaker was capering like an ape in the foreground. *Go away*, he gestured. *Get out of the window!*

The monk nodded at once, still laughing merrily, and vanished from the window. Gunter kept shooting. Now the wind began to devil him, increasing its force until it was tugging at his clothes, pressing at him like a Tokyo commuter, hammering at his eardrums. The camera was just big enough to present sail-area to it; the wind kept trying to force it to the right. Gunter had image-stabilization circuitry, but knew that this much wavering was taxing it. He twisted slightly to his right to put his back toward the wind, shielding the camera with his hunched left shoulder. The wind pressed especially hard at his ankles, for some reason, and his feet began to feel chilly. *Oh fine,* he thought, *defective boots on top of everything else. I am definitely going to sue* somebody *when I get home!*

But almost as he finished the thought, he realized that his feet were actually *cold,* colder than they should have been even if the boots' heating systems had both failed completely. He glanced down, and discovered that he was standing ankle-deep in crystal clear water. It rose as he watched, climbing his shins.

He looked to the north, and saw the Kali Gandaki river returning, after five centuries, dividing around his feet. Now his ear could distinguish between the sound of its passage and the similar sound of the wind. For no reason at all he remembered the damned travel agent saying that the Tiji festival was also known as the Festival of Impermanence.

From above him, in the temple, came the continuous *BBBRRRRRAATTTTTTTT!* of a mountain horn, cutting cleanly through the wind and water noise to alert the village below, and this horn sounded to Gunter more like a brontosaur laughing. . . .

CHAPTER 13

Shimizu Hotel
January 18, 2065

Rhea was drifting helplessly in deep space—her air supply almost gone, her thrusters dry, gasping for air that wasn't there—when windchimes sounded in the distance. She sighed, came back to reality, saved her changes, folded the typewriter and tucked it in her pocket, and went to answer the door.

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It was Duncan, of course—the only person besides Rand, Colly and Jay for whom the doorbell would function while she was working. "Is Colly ready?" he asked.

His eyes seemed to ask several other things, and Rhea sighed again. *I wonder what my eyes are answering,* came the sudden thought. "Come in," she said, and looked away. "Max, please tell Colly Duncan is here."

"Beg pardon?" the AI said.

"Sorry. Tell Colly *that* Duncan is here." Rhea hated making syntax errors; it was professionally embarrassing.

After a pause, her AI said, "Colly says to tell you she's changing clothes and will be with you in two seconds."

They looked at each other. "Five minutes," they chorused together, and shared a grin.

Almost at once something about that trivial event bothered Rhea. It was a domestic little moment, something she and Rand might have shared, a small intimacy. Rand had in fact been doing his best to generate such moments, lately—probably because the deadline for her Big Decision was approaching. That underlying awareness had been making the return-grins she gave her husband slightly forced. The grin she had just given Duncan was quite genuine. She realized she was drifting just perceptibly toward him, and overcorrected. "Come on in," she said to cover it. "You know where everything is."

"Are you working?" he asked, entering the suite.

She hesitated. The question meant, do you want to be left alone? Duncan was very understanding of a writer's problems; if she said yes, she would cease to exist for him. "No," she decided. "Can I get you anything? There's time for coffee."

"No, thanks," he said. "How's the work coming?"

"Not bad, thanks to you. I really struck ice with Buchi Tenmo."

He grinned again at the spacer expression. Spacers didn't give a damn for gold or diamonds or oil: for them a new source of water was real wealth. She had picked up the idiom from him—and it seemed to please him that she had. "Yeah, she's pretty amazing . . . when you can tell what the hell she's talking about."

"Yes, there is that. It's like talking to an angel on psychedelics sometimes. Would you mind sitting in on the conversation once or twice? You've been talking with Stardancers a lot longer than I have."

"Sure—but don't expect that to help much. Buchi's just *different.* Even for a Stardancer. The ones born that way, who've never breathed, are the weirdest—but the most interesting, too, I think."

A week ago, Rhea had asked Duncan how one got to know a Stardancer. She knew it could be done simply and easily, even from the surface of Terra—but how did one scrape up an acquaintance? It turned out Duncan was friendly with several Stardancers. Most spacers were. And one of his personal friends among *Homo caelestis* happened to be physically located near enough to Shimizu to allow for something very like a face-to-face meeting, through Rhea's

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own window. Duncan had made the introduction a few days earlier, then politely left them alone. "When would be good for you in the next few days?"

"Any time; when's good for you?"

She thought about it—and suddenly realized that the search criterion with which she was examining her calendar was "times when Rand and Colly won't be around." That made perfect sense: the conversation would be confusing enough without distraction. Nonetheless it struck her all at once that she was making a date to be alone—or almost alone—with a handsome young man. One who, if she wasn't misreading signals, was interested in her.

It's for work, *for heaven's sake!*

Yes . . . but is it prudent?

Oh, shut up. "How about tomorrow night, after twenty?"

He nodded. "Program loaded."

There was a brief silence. Rhea felt compelled to break it. "So how are things with you?"

"Pretty good, actually. I made another piece last night, and it turned out well."

Duncan's hobby was vacuum-sculpture. To Rhea the art form seemed to consist of assembling ingredients in various combinations, exposing them suddenly to vacuum, and then taking credit for the weird and beautiful shapes chemistry caused to occur. But vacuum-sculpture could be very beautiful—and she had to admit that Duncan seemed to produce aesthetically pleasing results more often than chance could account for. Didn't photographers throw out twenty prints and take credit for the perfect twenty-first? Come to think of it, wasn't her own storage partition cluttered with drafts that hadn't quite jelled?

"I'd like to see it," she said politely.

"No problem. We'll talk to Buchi from my place, then."

She opened her mouth . . . and then closed it firmly. He was pointedly not looking in her direction.

"I thought I'd take Colly to the pool again," he went on.

Rhea laughed. "You think you have a choice, huh?" The laugh sounded too loud in her ears. "She's a born water baby. You couldn't keep her out of the surf, back ho . . . back in Provincetown. You know, I've always thought it's ironic. As far back as history goes, the Paixaos have made their living on and from the sea—and my mother was the first one in the family that ever learned to swim. How could you spend all that time on the water and not know how to swim? Weren't they scared?"

Duncan shrugged. "I've lived all my life in space—and I don't know how to breath vacuum."

"But that's not possible—and it is possible to learn to swim, and it doesn't even take much time."

"Look at it from your greatest grandfather Henry's perspective," he said. "Suppose you're off the Grand Banks and the ship sinks. How much good does it do you to know how to swim?"

It occurred to Rhea that Duncan knew a lot more about her family than she knew about his. She was not normally so forthcoming; had he

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been making an effort to draw her out? She reviewed memory tape, and could not decide. "I guess. It still seems odd. Maybe we should ask Buchi to teach you how to breathe vacuum."

And now I've drawn the conversation back to our rendezvous. . . .

Colly appeared just then. How she could have spent five minutes dressing was something of a mystery, for she was dressed for the pool, in the ubiquitous guest robe and nothing else. Since so many nationalities and cultures mingled in the Shimizu, all guests conformed to a minimal nudity taboo in politeness to the less civilized nations; one did not jaunt down public corridors naked. But a guest robe was sufficient, and even those could be dispensed with once one reached the pool—or any other nonpublic location. "Hi, Duncan! Come on, let's go!"

"Sorry to hold you up," he said ironically, and made way so Colly could hug her mother goodbye.

As Rhea handed the child off to Duncan, their hands brushed briefly. Rhea had gotten used to casual touching in space, even from strangers; free fall made it necessary in close quarters. But this touch she felt from her scalp to the soles of her feet. It seemed to her that he made it linger.

She was glad then for Colly's eagerness to be in the water; the two headed for the door before the blush reached her cheeks.

I should have said yes when he asked if I was working.

In fact, she *should* be working. She took her keyboard from her pocket and unfolded it. Work would be a wonderful distraction from the trend her thoughts were taking.

Almost at once she found another distraction. The virtual screen that sprang into existence over the keyboard was preset to display her calendar as its boot document, so she wouldn't start sinking into the warm fog if there was some imminent obligation scheduled. It showed the next thirty days, and the box for 5 February was highlighted—it leaped out of the screen at her, as it had been doing ever since she had highlighted it.

I have two more weeks to make up my mind whether I'm going to stay here, was what she had thought when she first started work that morning. Now, perhaps because of what had just transpired, it came out, *I have two more weeks to make up my mind whether I'm going to stay married to Rand.*

She entered her date with Duncan into the calendar, put the typewriter away again, and went to the window. She watched the majestically turning Earth for a measureless time, trying to put names on her feelings and failing. They would not hold still long enough.

Finally she looked around her, as if to make sure she was alone, and checked her watch to make sure Rand was not due home, and spoke to her AI. "Maxwell: window program 'Home.' "

"Yes, Rhea."

Terra went away, and was replaced by Provincetown.

She was back in her own writing room in her own home looking out

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of the turret through her favorite window, hearing the sounds of the street below, hearing the gulls and the distant surf, seeing Mrs. Vasques, her neighbor, haranguing yet another motorist who had clipped her fence in trying to negotiate the insanely narrow street. The illusion was nearly perfect—except for the same flaw it had had weeks ago, when Rand had first sprung it on her. This time, she was able to identify the flaw. *This Provincetown didn't smell.* There was no salt tang in the air—none of that rich aroma that the landsman calls the smell of the sea and the sailor calls the smell of the land, the shore-smell of decaying vegetation and sea creatures at the border between two incompossible worlds.

Maybe I could get a steward to bring me some fish leftovers, she thought, and began to cry. Fetal position is hard to achieve in free fall, but she managed it.

She never did get back to work that afternoon. But she did manage to stop crying an hour before Duncan was due to bring Colly home for supper, so that her eyes wouldn't be red when they arrived.

Rand showed up just as they did. He had been making a major effort to eat most meals with his family, these days. For some reason, his arrival relieved her. Duncan declined an invitation to join them for dinner, and that relieved her too. During the meal she found herself paying more attention than usual to her husband, asking questions about his work and listening attentively to the answers, making little excuses to touch him. Before she knew it they had made a nonverbal contract, entirely by eye contact, to make love when he got home again that night. He went off to Jay's place whistling.

She managed to get a little work done after supper, while Colly was off playing with a friend. She didn't understand where the story was going, but it wouldn't let her alone; its disturbing central image—adrift, running out of air, no direction home—had been recurring in her thoughts for weeks now. The question was, of course, *who* was adrift, and why? She had no clear idea as yet, but she knew if she kept playing with the situation it would come out of her eventually.

As she was putting Colly to bed that night, she said, "So—was it fun playing with Jason, honey?"

"He's OK, I guess," Colly said. "For a boy, anyway. At least he's gonna be here a whole two weeks." For Colly, the biggest flaw in Shimizu's accomodations was its criminally inadequate and excessively fluctuating supply of eight-year-olds. Children of transient guests rarely remained aboard more than a few days; permanent guests tended not to have small children, and by evil luck all the spacer children of hotel staff were either over ten or under six—less use than a grownup. Colly still had all of her phone friends, of course, and her Provincetown chums were all phone friends too, now... but she was chronically short of playmates she could smell and touch.

"Oh, that'll be fun," Rhea said.

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"I guess." Suddenly Colly looked stricken. "Hey, Mom?"

"Yes, dear?"

"I just thought of something. My birthday comes in two and a half weeks, right?"

Rhea did mental arithmetic. "That's right, honey. Why?"

Colly sat up on one elbow. "*How am I gonna have a party?*"

Rhea started to answer, and stopped.

"You can't have a birthday party on the *phone*," Colly said. "And all my friends are back on Earth! I'm not gonna get to have a real party, am I?" Her voice was rising in alarm.

"Uh . . . sure you will, honey. There'll be kids aboard then, I'm sure there will. One or two, any—"

"But I won't *know* them," Colly insisted. "What good is a party with people you don't even know?" She started to snuffle.

Rhea was tempted to join her. Instead she took Colly in her arms and rocked her. "Don't cry, baby. It won't be so bad. All your friends can be there on the phone—no, you know what? I'll tell you what: we'll get Daddy to merge all the phone signals into his shaping stuff, and your friends can be here almost like real, holographically, walking around and everything." As she spoke, Rhea was estimating the cost of such an event: assuming Rand had time for this, and valuing his time at zero, it came to roughly the price of two luxury automobiles back on Terra. They could afford it, now—but still. . . .

Colly considered the offer for a moment, then resumed snuffling, softer than before. "That'd be better, but you can't tickle a holo, Mom. You can't throw pieces of birthday cake at a holo."

"Sure you can—only it's even better, because nobody really gets messy. You wait and see: it'll be fun."

Colly was dubious, but after ten minutes of rocking and cuddling and soothing she allowed herself to be mollified, and went to sleep. Rhea left her bedroom exhausted and heartsick. Colly was right: a birthday party aboard the Shimizu probably wasn't going to be much fun.

Less than a minute later, Rand arrived home, shiny-eyed and eager to make love.

Since adolescence Rhea had known that a contract with a man to have sex at an appointed time *must* be honored, if at all possible. Feeling martyred, she pasted a smile on her face and cooperated. But she made a mental note to discuss Colly's birthday party with him as soon as they were done; she was not 100 percent sure the consolation prize she had promised her daughter was technically feasible.

It was just as he was entering her that it dawned on her that the question might be moot: their child's birthday came *after* the date on which she was to give Rand her final decision. . . .

It was not a terribly erotic train of thought. The act was technically successful for both of them, for they had been married for a long time—but for the same reason, Rand asked, "Want to talk about it?" when their breathing had slowed.

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She burst into tears. "I don't even want to *think* about it."

He held her close, but said nothing. He knew, in general, what was on her mind—and knew that she knew he knew. What was there for either of them to say?

What could Donny Handsome have said to Patty?

She untucked her chin from his neck and pushed at him with her hands; he rose far enough on his elbows so that she could see his face. She looked at it a long time . . . not just the eyes or the mouth, but the whole face. He waited. "You're staying?" she said finally.

His face went blank. He was silent an equal time. She waited.

"Yes."

She nodded, and pulled him back down to her. They lay there together in silence, breathing in the same rhythm and thinking the same thought.

What did that nod mean?

Twice, she felt him start to ask her. Each time he changed his mind. She couldn't blame him—but part of her wished he had asked. If he had, perhaps an answer would have come to her.

She forgot to ask him about Colly's birthday party that night.

Rhea knew that a real window like the one in her suite was supposed to be much better than a fake one—she knew, to the yen, how much more the former cost. But she was a shaper's wife: to her Duncan's fake window was just as good. Better, for she could shift to a view in any direction at all simply by touching a control. Somehow it felt more correct to talk with a Stardancer *without* Earth in the background, overshadowing everything.

And Buchi Tenmo did not appear to mind talking to a camera rather than a person in a window. She did not need to see Rhea; she already had. She must be used to talking with Duncan this way, too.

Insofar as she was used to talking at all. So far Rhea had found it always took the first few minutes of the conversation for Buchi to become even partly comprehensible. That did not surprise Rhea. To temporarily "place on hold" an ongoing conversation with millions of others, and funnel consciousness down to only one or two, nontelepathic minds must be a disorienting experience—especially for a spaceborne Stardancer, who had never been such a limited being herself. The wonder was that the trick was possible.

And already Buchi was winding down, only minutes in. She had progressed from incomprehensible polyglot babble to a lock on English—of a sort. Any minute now it would start conveying information.

"—As the world whirls around peg in a square holy cowhide it from yourself-esteem cleaning up your action figures it would be that's entertainment to tell you but I forgot is a concept by which we measure painting the town read all of your books now, Rhea, and they're very beautiful . . . the gostak distims the doshes . . . eftsoons, and right speedi-

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ly . . . don't blame him for not being careful in the beginning . . . a straight hook basically seeks fish who turn away from life . . . there: subject, object, predicate . . . am I getting there, Rhea? Duncan? Can I hear you, now? Are we having fun yet?"

"You're getting there," Rhea agreed. Things always improved dramatically, she had found, once Buchi reinvented the sentence. She found herself asking the question she had suppressed during her previous encounters with the Stardancer. "Buchi? Does it hurt? Doing this, I mean, talking with us—is it hard?"

"It's fun!" For that moment Buchi sounded remarkably like Colly. *"Is it hard to talk with me?"*

"A little," Rhea admitted. "But you're right, it's fun. But then, I'm only doing what I do all the time: talking, in my own language. You're doing all the work."

"By 'work' I understand you in this context to mean 'energy expenditure regretted or begrudged.' By that definition I have never worked in my life. Although I'm always busy."

"I wish I could say the same." A light dawned somewhere in the back of Rhea's head. "But you've put your finger on something, Buchi. I've been thinking about our conversations, and why they haven't satisfied me, and I think you just gave me a handle on my problem."

"Problems are better with handles on them?"

"For me they are. Looking back over it, everything I've been asking you has been about . . . has had to do with things that a human supposes would be disadvantages of being a Stardancer. The bad parts. I've been asking you about the bad parts—and for each one I come up with, you explain how it's not a bad part. Some of the explanations I just flat don't understand—"

"I always have trouble conveying the idea of self-generated reality," Buchi agreed. *"To a human it seems a flat contradiction in terms."*

Rhea had asked in her first conversation whether Buchi ever missed being able to "really" walk the surface of a planet, as opposed to "merely" reexperiencing it through the memories of those Stardancers who had lived on Earth before joining the Starmind. Communication had broken down when Buchi insisted that she could, really, walk on Terra any time she wanted—that she could "really" experience things she had never personally experienced—knowing the difference, but unbothered by it. Rhea, who had never confused even the best virtual-reality environments with real-reality, was baffled by this. She had spent most of her own professional life battering at the interface between almost-real and real, trying to make words on a screen sound and smell. She had to tiptoe around the thought that anyone for whom reality and imagination were interchangeable was someone who was not quite sane.

"—But that's not the problem," she went on, but Duncan interrupted her.

"It's like this window, Rhea," he said, touching her wrist and pointing.

"Huh?"

"You know that to most of the peo-

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ple in this hotel, this window we're looking out right now isn't as good as the one you have back in your suite. God knows it costs a lot less. But we've talked about it, so I know you agree with me that this one is actually better. It may not be 'real'—but it can look in any direction you want, or show you anything you want to see, flatscreen anyway. I know yours can do even better, the way Rand has it tricked out now, but most people who pay a premium for one of those windows do it so they can tell themselves that what they're looking at is 'real.' They care a lot about 'real.' You and I care a little less. Buchi cares not at all. Think of it as a spectrum rather than a discontinuity."

Rhea looked at him, surprised and a little impressed by his insight. "I think I see what you mean," she said.

He flushed and went on. "With total control of her brain and body, reality can mean whatever she wants it to mean. She can *experience* the touch of someone half a light-year away, feel it on her skin. Or feel the touch of someone long dead . . . as long as someone in the Starmind holds the memory of how it feels to be touched by that person. Not one coffee molecule has ever passed her lips her whole life long, but she's probably tasted better coffee than you or I ever will."

"*I'm doing it now! 'Bean around the Solar System. . . .'*" Buchi let the song parody trail off after a few more hummed bars.

"But with reality that slippery—" Rhea began.

Duncan interrupted. "—How do they make sure they don't lose track of the one you and I believe in? What do they do for a reality check, you mean?"

"Yeah, I guess that's what I mean."

"*We are many,*" Buchi said. "*And we are one. E pluribus unum. Alone/All-one. Consensus reality is very important to us. If we ever lost it, we would come apart. It is the same with your own neurons. We put about as much effort into it as they do. And about as often, we fire randomly—we make things up, we vacation in realities of our own fashioning, singly or in groups. The Universe is always there when we return. It is not a problem.*"

"Now *there*," Rhea said triumphantly, "is *my* problem. As I started to say before, I can live with the fact that I have trouble grasping your explanations of why assorted aspects of being a Stardancer aren't problems for you. What's driving me crazy is that you just . . . don't seem to *have* any problems!

"None of the ones I envisioned is. None of them has even triggered mention of any problem you do have. I'm a writer: to me a character *is* his or her problems; if they don't have any, they're no use to me, I've got nothing to work with, no way to motivate them. I guess what I'm asking is, don't you people—you Stardancers—have any problems? I know you never get hungry or thirsty or cold or lonely or lost or have to go to the bathroom at an inappropriate time. But Jesus, Buchi—isn't there *anything* you fear? Or miss? Or yearn for? Or regret? Is there anything you lust

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after? Or mourn?"

"*Must your characters always be driven by the lash?*"

Rhea thought about it. "Pretty much, yes. That's what the audience wants to see. How someone like itself reacts under the lash. Because it helps the reader guess and deal with how she would react under the same pressure. The rule of thumb is, the sharper the lash—the tougher the antinomy—the better the story. For us humans, life is suffering, just as the Buddhists say. Is that really not true for you?"

The answer was almost a full minute in coming. It was the first time Rhea could remember Buchi hesitating even slightly in responding. Two or three times she began to speak, but each time decided to wait for an answer.

"*The Starmind suffers,*" Buchi said at last. "*As sharply, as deeply, as keenly, as you yourself. But in different ways . . . for different reasons . . . and I cannot explain them to you. No terrestrial language contains words that will convey the necessary concepts: you do not have the concepts. Every human language contains the implicit assumption that individual minds have bone walls around them. It would be much easier for me to convey color to a blind man.*"

Rhea was frustrated, but if there was anything her work had prepared her to believe, it was that some things simply could not be put into words. "What are you all *doing?*"

"*What are you asking?*"

"What is the Starmind doing? Are you doing *anything?* Did those Fireflies have any *purpose* in creating your kind? Are you all working toward something together . . . or just floating around like the red blobs in a lava lamp, marveling at the Solar System and unscrewing the inscrutable?"

"*You know hundreds of things we do. I can download a summary list to your AI if you wish. It runs about a terabyte.*"

"Then I've seen most of it. Well, scanned it." Even that was an absurd claim. "All right, I've scanned the superindex, tiptoed through some of the subindices, and jumped in at random here and there a few hundred places. And one thing I noticed."

"*Yes?*"

"Most of the things you do come down, in the long run, to helping *us.* Helping humans. Helping Terra. Some of it benefits us directly, like nanotechnology, and some it just seems to happen to work out to our benefit way down the line, like that Belt-map hobby of yours that kept us from getting clobbered by Lucifer's Hammer in '32. Even the 'pure-science' researches you're engaged in always seem to benefit us more than they benefit you, when the dust settles."

"*Can we ignore suffering at our own heart, at our roots? We may not be* of *humanity . . . but we are* from *humanity.*"

"I'm not complaining. I'm just asking: is that what you Stardancers do for problems? Borrow ours?" She had an image of the human race as endearingly dopey pets, who could be relied upon to produce fascinating but trivial problems, supply life's necessary irritant. "If some cosmic disaster wiped us

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all out . . . would the Starmind go crazy from boredom? Or would you still have things to *do*?"

Another pause. This one was only ten seconds or so. "*We would still have a nearly infinite number of things to do. And again, I despair of finding words that will successfully hint at their nature.*" Another five seconds. "*One subset may perhaps be intelligibly outlined, at least. You are aware, are you not, that the Starmind is not alone in the Universe?*"

"Huh? Sure. So what?" It was a classic insoluble problem. Within a few years of its initial formation, the Starmind had reported to humanity that it was receiving telepathic broadcasts from numberless other Starminds throughout the Galaxy and Magellanic Clouds—a potential source of inconceivable wealth in any terms. But it came in *all at once*, at the same "volume," from all quarters—and none of it appeared to be in any known or decipherable language or concept-system. The Starmind did not even know how to say, "Quiet, please—one at a time!" The best it had managed, according to all reports, was to learn to ignore the useless infinity of treasure, as a geiger counter suppresses its "awareness" of normal background radiation. "What good does that do you if you can't *communicate* with anybody?" Rhea asked. "You can't, right?" She knew the answer—but from books and media accounts, and knew how much that was worth.

"*No, we cannot*," Buchi agreed. "*But that may not always be so.*"

"You think the problem might actually be solvable?" Duncan said excitedly.

"*Our seed has been awake for less than seven decades*," Buchi said. "*There are yet far fewer of us Stardancers than there are neurons in even the most limited brain. Yet our numbers grow—and the Starmind grows wiser every nanosecond. It is certain that we live longer than you, and we do not waste a third of our lives in stupor and another third working at life-support. We have time. Time has us. We use tools you cannot understand to build tools you cannot conceive to solve problems we ourselves cannot name. It is not a thing to trouble yourself over.*"

"Do you know anything at all about where it's all going?" Rhea asked. "That you can explain?"

"*Yes.* Wonderful *things are going to happen.*"

Rhea blinked. "But *what?*"

The silence went on until she realized no answer would be forthcoming. "When?" she tried then.

That answer came at once, startling her.

"*Soon.*"

"*How* soon?" she blurted.

Again, silent seconds ticked by.

"Within my lifetime?" she tried.

"*I cannot be certain, but I believe so.*"

"Will you be able to explain these things to us humans when they happen?"

"*When they happen, you will know.*"

"And you can't give me any idea what it will be like?"

More silence.

"Why doesn't anybody else know about this?" Rhea said irritably. "I've read—scanned—everything I could

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get my hands on about you Stardancers. This is the first hint I've heard that the galactic signal-to-noise problem might be susceptible of solution. Is it a secret, or what?"

"*Would I have burdened you with a secret without warning you? The reason you have not heard of this before is that you are the first to have asked about this in many decades, the first since we began to be sure of it ourselves.*"

"Really?" Rhea asked. "That's hard to believe."

"*Yes, isn't it? Rhea, answer me two questions. First, regarding the Fireflies who made us: is there any characteristic commonly associated with the term 'gods' that they lack?*"

Rhea thought hard. Apparently omniscient, apparently omnipotent, apparently benevolent but absolutely unknowable . . . long gone and not expected back soon. . . . "No," she admitted. "Wait: two. They seem to have no desire at all to be worshipped . . . and they haven't instructed anyone to kill anyone else in their name."

"*You anticipate my second question: do you know of any religion on or off Terra which worships them?*"

It startled her. "Why, no. There are cults who worship *you*, at least one large one. And up until forty-odd years ago there was a small one trying to kill you. But I don't know of any Firefly-worshippers, now that you mention it."

"*Rhea, humanity can just barely live with the mere* memory *of the Fireflies. They are too vast to think about. From the human point of view, the best thing about them is that they were in the vicinity of Terra for a matter of hours, at the orbit of Saturn for a matter of months, and left promising my father not to return for a matter of centuries. We Stardancers are tolerated, for all our alienness, because we were once and still partially are human. Beneath my Symbiote are flesh and blood, born of woman. But of all the things we are asked—and we are asked many things by many humans—we are rarely asked about the Fireflies . . . and almost* never *about* other *Starminds, circling other stars. Your governments and philosophers were overjoyed to learn that the galactic surround is incomprehensible to us, and have been happy to tiptoe around the sleeping dragon ever since.*"

"If that's true, I'm pretty disgusted with my own species," Rhea said.

"*You need not be. Think of it from a historical perspective. After two millions of years of slaughter, humanity has* just *learned how to live with itself in peace, and has done so for a time measured in mere years. Can you reasonably expect it to be prepared to deal with a* Galaxy *of unknown strangers? So quickly? I can tell you that* we, *the Starmind, tremble at the thought of the Fireflies returning—and we could at least talk with them if they did. Why should you not 'pretend it never happened'? It seems to me a healthy psychological adjustment for your race at this time.*"

Rhea started to reply, but Duncan interrupted her again. "Excuse me, Buchi—I want to backtrack a second. Did you say when the Fireflies left,

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they made a promise to 'your *father*'?"

"*Yes.*"

That had caught Rhea's ear too. "Who is your father, Buchi?" she asked.

"*Charlie Armstead.*"

Rhea's eyes widened. "And your mother?" she managed to ask.

"*Norrey Drummond.*"

She heard a singing in her ears, like a Provincetown mosquito. The second and third Stardancers who had ever lived, founders of Stardancers Incorporated, as famous throughout even the human race as Shara Drummond herself! "My God! I never dreamed—"

"Me either," Duncan said in awed tones. "You never told me that, Booch."

"*You never asked. What's* your *father's name, and why haven't you told me?*"

"It's 'Walter.' But you're right. His name only comes up if someone finds *my* name funny and I have to explain the story."

"*I saw the humor in your name the moment you told it to me,*" Buchi said. "*But I assumed you were tired of explaining its origin, so I did not comment.*"

"And bless you," he said. "It's just that I keep forgetting you folks don't use last names to indicate either paternal *or* maternal descent."

"*There is no need to. We* know *our lineage, and each of the other's—it need not be encoded in our names. We choose names purely for their meanings.*"

The humming in Rhea's ears was beginning to diminish. "What does your name mean, Buchi Tenmo?" Rhea asked.

"'*Dancing Wisdom Celestial Net.*'" the Stardancer answered.

"That's beautiful!" Duncan said, an instant before Rhea could. "I wish I had a name that good." He turned to Rhea. "Or like yours. 'Rhea'—'Earth' or 'mother,' two of the most beautiful words there are. And 'Paixao,' just as beautiful: 'passion.'"

The mosquitos resumed their attack on Rhea's ears. She could feel the lobes turning red, offering blood. "What does *your* name mean?" she asked quickly, aware of the significance of his having looked up the meaning of her name, but unwilling to acknowledge it.

He made a face. "I got the booby-prize. 'Duncan' means 'dark-skinned warrior'—" Rhea found herself thinking that he was dark-skinned even by Provincetown standards, though he certainly wasn't *muscled* like a warrior . . . and forced herself to pay attention to what he was saying. "—and 'Iowa' . . . well, there's the political district in the North American Federation, of course, the province or state or whatever—and at least one writer once confused that with Heaven. But actually it comes from 'Ioakim'—apparently an official at someplace called Ellis Island made Greatest Grandad change it. It's Russian Hebrew for 'God will establish,' which I for one find wishful thinking."

Rhea found that she wanted to change the subject from Duncan's name, from Duncan, and suddenly remembered a question that had ghosted through her mind perhaps a

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dozen times over the course of her life. "The word 'God' makes me think of Fireflies again," she said. "Buchi, there's one more question I've always wondered about. Why did the Fireflies come when they did?"

"*They came when it was time.*"

"Yes—but why was it time? The generally accepted answer is that they came 'at the dawn of space travel.' But it was more like brunch-time. Humanity had been in space—had been established in space—for years when they showed up. We'd been to Luna decades before. Did it take them that long to notice? Or that long to arrive? If we could establish a time-duration for their journey, it might be a clue to where they came from."

"*Their arrival was instantaneous,*" Buchi said flatly.

"Then what triggered it? Do you know?"

"*The signing of a contract. An agreement between Skyfac Incorporated and Shara Drummond.*"

Details from a history lesson came back dimly to Rhea. Sure enough, the way she remembered it, the Fireflies had first been sighted in the Solar System about two weeks before Shara Drummond left Earth to create the Stardance. They had flicked into existence at around the orbits of Neptune and Pluto (at that time very close together), the outer limit of the System, and then moved in as far as the orbit of Saturn a couple of weeks later....

... The day Shara reached Skyfac! Where they stayed, until she was on the verge of being sent home again with her dream unfulfilled—then arrived just in time to force the performance of the Stardance.

"*They came to us the moment that a human being came to space for the express purpose of creating* art," Buchi said.

The words seemed to echo in Rhea's skull.

"*How they knew of that, even the Starmind cannot yet imagine—but the fact is unmistakable.*"

She felt as if her head were cracking. The insight was too immense and powerful to deal with—yet so obvious she could hardly believe no one had worked it out ages ago.

"Thank you, Buchi," she said quickly. "You've been very gracious and helpful, we'll talk again another time, I hope you'll excuse me now but I need to get to my typewriter so I can—" She stopped babbling when she noticed that she had already switched off the window.

She turned from it, and there was Duncan.

At once he turned away, which relieved and annoyed her at the same time, and jaunted across the room. But in seconds he was back, bearing a strange and uncouth object, waving it at her as he braked himself to a halt at her side. "I promised I'd show you this, Rhea," he said.

It was his manner more than anything else which cued her. This had to be the new piece of vacuum sculpture he had mentioned. Resolving to find something polite to say about it, she began to scrutinize it for material to work with.

A timeless time later, she began to experience perceptual distortion, and

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slowly figured out the cause. Her eyes were trying to grow tearbubbles....

What it was made of she could not guess. The subtleties of its composition process were a closed book to her. But what it looked like, to her, more than anything else she could think of, was a piece of driftwood she had once brought home from the Provincetown shore. It had a similar shape, twisted on itself, asymmetrically beautiful, and it had the stark bleached color and polished appearance of very old driftwood. Washed up on an alien shore... like herself.

"It's very beautiful," she said, and heard a husky note in her voice. She searched for polite small talk. "Does it... do your pieces have names?"

"It's called 'Driftglass,' " he said. His own voice was hoarse.

She flinched slightly. "It's very lovely. It reminds me—"

"—Of home, I know," he said quickly. "It's yours. I made it for you."

The mosquitos at her ears had brought in chainsaws. "I... I really have to go," she said. "I promised Rand—" She was already in motion, three of her four thrusters firing at max acceleration, past him before she could see his reaction.

"Sure, of course, goodnight," she heard him say behind her as the door got out of her way, and as she came out of her turn and raced down the corridor, she was for a time very proud of herself. Until she noticed that she had Driftglass in her hand....

And I didn't even thank him.

"You are going too fast," came a voice from all around her. "Please slow down." She flinched, and then realized it was only an AI traffic cop; she was exceeding the local jaunting speed limit. She decelerated at once.

"Thank you," she said. "That is very good advice." ■

To be continued in the next issue.

The density of intelligence in the Universe? Try to compute the density of a planetary atmosphere given one molecule of that atmosphere!

Donald Kingsbury

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Gun, with Occasional Music, Jonathan Lethem, Harcourt Brace & Co., $19.95, 218 pp. (ISBN: 0-15-136458-3).
The Stainless Steel Rat Sings the Blues, Harry Harrison, Bantam, $19.95, 231 pp. (ISBN: 0-553-09612-5).
Islands of Tomorrow, F. M. Busby, Avon, $4.99, 348 pp. (ISBN: 0-380-77231-0).
Edge of Infinity, Jeffrey Groteboer, Mayhaven Publishing (P. O. Box 557, Mahomet, IL 61853), $6.95, 275 pp. (ISBN: 1-878044-13-3).
Hour of the Octopus, Joel Rosenberg, Ace, $4.99, 263 pp. (ISBN: 0-441-16975-9).
A College of Magics, Caroline Stevermer, TOR, $22.95, 380 pp. (ISBN: 0-312-85689-X).
The Broken Goddess, Hans Bemmann, ROC, $9, 216 pp. (ISBN: 0-451-45348-4).
Off the Wall at Callahan's, Spider Robinson, TOR, $9.95, 161 pp. (ISBN: 0-312-85661-X).
Specula: Selected Uncollected Poems: 1968–1993, Bruce Boston, Talisman (P. O. Box 321, Beech Grove, IN 46107), $6.95, 64 pp. (ISBN: 0-9626708-5-5).
Roger Zelazny, Jane M. Lindskold, Twayne Publishers, $?, 167 + xvi pp. (ISBN: 0-8057-3953-X).

Toward the end of Jonathan Lethem's first novel, **Gun, with Occasional Music**, we discover a world in which it is illegal to know what you do for a living. You are legally required to take massive doses of "Forgettol," a cocainishly snortable drug or "make." As a side-effect, you haven't a clue to the various ways the establishment is exploiting you. Protest is obviously impossible.

Satire? Of course. But it's satire with a real point, and Lethem doesn't spring it on you without preparation. First he lays out the world of a few years previous, some time after the Inquisition's rise to power. The Inquisition is the police; its Inquisitors are the only ones allowed to ask questions; even a polite, "Have a good time Saturday?" is apparently consid-

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ered rude, immoral, and grounds for social snubbing. The printed word has been banned, and the radio news is done in music only, the newspaper is nothing but pictures.

That is, the establishment has banned journalism, investigation, inquiring minds, and everything else of the sort. To help, there are a variety of "makes," designed to emphasize regret, acceptance, forgetting, and so on, all with addiction in common. Yet not everyone accepts the situation. Meet ex-Inquisitor Conrad Metcalf. He couldn't take the official line, so he became a free-lance Inquisitor, the equivalent of an old-time private eye. His most recent client was Maynard Stanhunt, who wanted Conrad to investigate his wife's marital infidelities. Now Stanhunt is dead, and the local Office of the Inquisition is busily trying to sweep the case under the nearest rug. They also try hard to discourage Conrad—even docking his karma account to dangerously low levels (lose all your karma, and they put you in the freezer for a few years)—but Conrad doesn't discourage easily. He keeps asking questions, finds connections to a gangster with an evolved-kangaroo gunsel named Joey, collects plenty of clues and a few lumps, and finally pisses off the chief Inquisitor on the case enough to lose all his karma.

Off to the freezer for the next six years. When he gets out, the Inquisition's control of human thought and knowing is all but absolute. And Conrad is still on the prod.

I found this one interesting, but not—despite the classic tough-guy private-eye ambience—gripping. The problem is that Lethem's version of human society functions only as a symbol of what he is trying to deal with. There is therefore a deep conflict between the gritty realness of the ambience and the abstraction of the symbol that serves neither well.

There is a sub-industry of stage, screen, and print that appeals to everyone who has ever cherished a hankering to be a pirate or a cat-burglar. That's most of us, of course, at least at some time in our lives, so it's no surprise that Harry Harrison's saga of Slippery Jim diGriz shows no sign of ending. The Stainless Steel Rat has *just the right layer of grease* on his ethics and the perfect talent for escaping the tightest of jams. His appeal for the audience is undeniable.

Sadly, I think the earlier tales in the series were stronger than the latest, **The Stainless Steel Rat Sings the Blues**. At that time, Harrison spent more effort developing Jim's personality, background, and context. Now he does little more than tell the reader, "This is Jim. Remember him? Here's the fat-headed cop, the vicious soldier, the. . . ." It's button-pushing, which is permissible for the sake of keeping things brief and moving, but it's also blatant, which leaves the reader feeling insulted.

Within *Blues*'s first dozen or so pages, Slippery Jim has tried to rob a new and colossally tempting mint, been caught and sentenced to immediate death, and rescued by a general who just happens to need a dab of slippery scum. An alien artifact has

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been lost on the planet to which the galaxy has long sent its worst criminals and troublemakers. It's a hellhole, but they want that artifact back. Jim will lead the recovery expedition, disguised as a musical group, or the mint's death sentence will be carried out. And to keep him motivated, he is slipped a poison that will kill him in thirty days unless he gets the antidote in time.

Does the formula seem familiar? Jim and his companions will get into and out of a series of jams that illustrate the nature of the snakepit world and the moral bankruptcy of those who operate it. He will gather a series of clues. Eventually he will find the artifact and achieve a measure of revenge. Logic and verisimilitude will take a back seat to fast and furious action.

It's fun, but not fun enough to get me to spend hardcover prices. Paperback, maybe.

F. M. Busby does a better job with his latest, **Islands of Tomorrow**. That is, he gives us a fun tale that pays more attention to logic and verisimilitude. Unfortunately, I can't say much more in its favor.

Not too far in our future, the state of Washington (where Busby lives) has imposed sales taxes (misery taxes) on just about everything, including medical expenses. Now it is about to extend its grabbiness to college tuition. Students at Washington State University are understandably annoyed. With a Big Game coming up, with the governor scheduled to be on hand, what could be more natural than a nice, understated protest?

Well, that's the way it starts. But one of the protest's ringleaders is a charismatic fellow named Derion who, when a stranger pops up in the stands and starts lobbing gas bombs, refers to "Lord Frey" and exerts his "will" to cool the scene off. Then he turns to Luke Tabor, Busby's protagonist, for a bit of help in departing the scene. "Will" takes it out of a fellow, you see.

Luke soon realizes something funny is going on. Derion even says he is from the Far Islands, somewhere not on any Earthly map. Frey and Derion each admit that their "will" is what we call telekinesis. And when the cops start arresting the protestors, Derion yanks Tabor and his friends into someplace rather murky. Soon Tabor drops into a strange world that turns out to be the distant future, far beyond a period when the Changed (those with "will") and normal humans fought a vicious war of near extermination. The world is now only thinly populated, and the genes that lie behind "will" are declining in frequency. Both Derion and Frey are collecting old-time humans to add vigor to the breed; they differ in how much attention they pay to informed consent.

Before long, it is very clear that Tabor and his friends are caught in the middle of several vicious conflicts. It is also clear what the "Far Islands" are: periods of time those Changed with the ability to time-swim can visit; if they linger past the end of such a period, they are trapped.

Complications abound, though

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Busby manages to pretend his characters can swap sexual partners without provoking much jealousy. When things get dicey, Busby manages to invent a new ability just in time, and the pattern is clear long before the end. Tabor and his friends are witnesses to the future, assistants in conflict, voices of reason when the Changed are being dumb. And in the end, they must return to their time and slip back—more or less—into their old lives, even as the Changed step off-stage to escape the chaos they have made of time and causation.

Tabor et al. are not entirely passive onlookers in this tale, but they are not nearly active enough, and their sexual shenanigans are too tame to satisfy the reader.

By the way, Busby does not seem to like fast food joints—he named one "ReBurgerTater."

Jeffrey Groteboer is a California game producer whose previous SF-related writing was adventures and rules variants for SF games. He's also a guy with a problem—cardiomyopathy, apparently caused by a viral infection—that was destroying his heart. In fall 1993, he became the first US patient to have a heart-assist device implanted in his body; in October, he had a heart transplant; at last report he was doing well.

In other words, here's a fellow who doesn't only *write* science fiction. He *lives* it. At least, he is alive today only because of devices that were no more than science fiction not very many years ago.

But he does write the stuff too. His first novel, **Edge of Infinity,** appeared in 1992, and a sequel is reportedly due soon. I haven't seen it, but I expect it will feel rather like *Edge*, which belongs to the SF subgenre devoted to rides on new and untested whizmoes.

The plot is pretty sketchy. Commodore Osiah, late of the Solar Peacekeeping Army, is operating a mining ship in the Belt when pirates attack, destroy his ship, and thereby bankrupt him. Hardly has the dust settled than he is offered the job of piloting a ship with an experimental ftl drive. He is told the odds of success are very low, the last such ship disappeared, and the ship's computer is just the sort of AI Osiah hates, but hey, he hasn't got much choice, has he?

I kept expecting Groteboer to reveal that the pirate attack was a set-up job, but he doesn't do that. He simply launches the ship, dumps it in an unrecognizable sector of space-time, asks the "How do we get home?" question, bumps his crew into a couple of unlikely worlds, and gets them home.

The technical underpinnings, by the way, are not Groteboer's strong suit, no matter how technically underpinned he is himself. Here's an example from p. 13: "Osiah was a mix of Japanese and Italian; as a result, his skin held a surplus of tannin. . . ." That's melanin, folks, not to mention a bit of dermal carotene from the Asian side of the family. Tannin is what you use to make leather.

* * *

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Hour of the Octopus is the second in the fantasy series Joel Rosenberg began with *D'shai*. If you recall, D'Shai is a feudal-oriental land whose people are blessed by kazuh, a calling or a muse, a sense of cosmic rightness and inspiration which, when it is on you, means that every move you make is not just right, not just superlative, but touched by divine fire. Until Rosenberg began the series, there were some fifty different kazuhs, one each for warriors, armorers, runners, cooks, acrobats, musicians, painters, even peasants. With *D'shai*, he introduced Kami Khuzud, an acrobat who had a talent for solving puzzles. By that novel's end, Kami's talent was recognized as a kazuh and his name was Kami Dan'Shir, Discoverer-of-Truths, elevated from the peasantry to the bourgeois class but still subject to every whim of "our beloved ruling class."

Now here's Kami again, treading an uneasy tightrope between those aristocrats who think he may prove useful and those who take the elevation of a peasant as a personal affront. Rosenberg exploits the tension to good effect as he shows us life in the castle of Den-Oroshtai, an impending political marriage, political schemes, and finally a murder that must be solved, or else. Any reader will enjoy the buildup, and any *Analog* reader is bound to get a special chuckle when Rosenberg has a wizard claim that quantum uncertainty—the kind behind the parable of Schrödinger's cat—is essential to a spell.

The end's not that bad either, but Rosenberg did not succeed in lulling me so thoroughly that I could swallow the shuffle that Kami uses to solve the crime without saying whodunnit. Kami has his reasons, of course, and he tells all before page last, but the shuffle left me feeling cheated so badly that telling all was no cure.

Caroline Stevermer is one of those Minneapolis writers—I mentioned Emma Bull, Pamela Dean, Steven Brust, Will Shetterly, and Patricia C. Wrede last month—who are making a splash in modern fantasy. They have an intriguing way of looking at things in a slightly different manner, as with Dean's *Dubious Hills*. Sometimes this works; sometimes it doesn't, but even then they deserve credit for trying something new.

Stevermer's latest novel is **A College of Magics**. The time is shortly after 1900. The setting is a Europe where the Ruritania of comic opera is a real land, though it is only mentioned. There are railroads, horse-drawn carriages and rare automobiles, a society topped with royalty and aristocracy. Manners matter, marriages are arranged, and rambunctious, prideful fillies can be shipped off to finishing schools such as Greenlaw, whose graduates are referred to behind their backs as "witches of Greenlaw."

Witches? Of course. This is fantasy, after all, and magic is a genuine force in the world even if it is barred from Greenlaw's hallowed precincts. The world is kept stable in its structure of concentric spheres or realms by the wardens of north, south, east, and

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west, and the witches of Greenlaw are often potent forces behind the political scenes.

Faris Nallaneen, duchess of Galazon, is one of those prideful fillies. Her uncle Brinker, who rules Galazon until she reaches her majority, has sent her to Greenlaw. She is homesick and rebellious but also equipped with enough common sense to let her adapt to the regime under which she must live. She also copes with a vindictively petty young woman from Galazon's rival neighbor, Aravill, and when that coping reveals hidden talents, she is sent from the school on a mission that will save the world and seal her own destiny.

Most of the book I found delightfully warm and cozy, a marvel of stern schoolmistresses, exploding hats, witchery on the Orient Express, and creative anachronism. I was prepared to love it all the way through. But once Stevermer had brought Faris to the scene of her climactic performance, discords began to creep in and gimmicks popped out of hats without adequate preparation. My reaction soured a bit.

I'm not giving details about what I didn't like because they would all be from the end, and giving them would spoil the tale for you—especially for those of you who wouldn't object to them. For the rest of you—I do think the tale is a pleasure to read; I just cannot bring myself to rave about it as I first thought I would.

Hans Bemmann's **The Broken Goddess**, first published in Germany in 1990, is an interesting fantasy that tries to throw some light on the very basic question, "What is the point of fairy tales?"

The narrator is a young scholar deep into the true significance of myth and folk tale. He talks of animal bridegroom motifs and shamanistic survivals and coded archetypal experiences. So do the other attendees at the conference at which he is speaking, all of them stuffed-shirt academics without a clue to the true nature of reality. But they are not all irredeemable—the narrator's enlightenment begins when he notices a young woman at the conference and is immediately enchanted. After his talk, she asks him, "Do you think fairy tales are really true?"

He is dumbstruck at her naivete, but he follows her out of the building and into the garden, where there is a tiny duck pond. The next thing he knows, he is a frog. He is also embarked on a voyage of self-discovery that will carry him through a number of fairy tales ("Cinderella" is only the most obvious) and introduce him to a few of the old gods, culminating with Hephaestus and Aphrodite. Toward the end he must come to terms with his past in a way that will allow him to treat a woman in a mature, nonselfish way.

The point of the voyage is summed up in the line: "The images and figures of this apparently imaginary world of fairy tale would have no real meaning for me until I allowed my own reality to take shape in them." His reward for success is self-fulfillment in the form of true love.

What are fairy tales, then? They are

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stories we tell each other as we grope for a way to escape those we tell ourselves and live in the world. Bemmann underlines this definition in the way he chooses to present his tale: The narrator is speaking to his loved one, the woman who has led him a merry chase and who he hopes has a similar idea of what is going on between them. At the beginning, "I was still possessed of what now strikes me as staggering self-confidence, the self-confidence that so irritated you at first and that I lost only during my quest for you, with all its metamorphoses and the many wrong paths I took." It is an epistolary voice, a bit cooler and more distant and more self-conscious than we are used to seeing in this country's fiction. But it is a smoothly assured voice, quietly convincing, very well translated by Anthea Bell. Bemmann's work deserves wide attention.

It has been twenty years since the first of Spider Robinson's tales of Callahan's Place appeared in this magazine. Since then Spider has used the venue many times, producing half a dozen collections and novels. Even though he wound up by nuking the Place, a corps of fervent fans persistently badger him for more, MORE, M*O*R*E!

Spider's also a Heinlein fan, and he's not above taking a leaf from his master's notebook. Where Heinlein spun *The Notebooks of Lazarus Long* from tidbits of wit and wisdom in *Time Enough for Love*, Spider has mined his own previous stories to assemble **Off the Wall at Callahan's**.

Most of the material, he insists, was recovered from photos that showed the wall behind Callahan's bar, where Callahan had been in the habit of writing down pithy thayings (Spider's joke, not mine), graffiti, puns, and so on. To this he adds a few songs and sketches of the chief characters. And the result is a charming little book that should please Callahan fans no end.

Bruce Boston's latest chapbook is **Specula: Selected Uncollected Poems: 1968–1993**. A peek at the *Encyclopedia of SF* reveals that these poems date back to when Boston was a mere lad of 25. It is therefore not surprising that some of them seem very much the product of youth, of a poet in love with the sheer sound of the language and not yet up to the maturity that we equate with the calluses and abrasions of time.

Which poems do I mean? Do let me be coy—they're not dated, so if I name one as callow and raw, he's bound to say, "Yah! Gotcha! I wrote that one just last year!" I'll just say I found "Objects and Ground"—in which the world rests on the back of an elephant standing on pillars held by Atlas standing on Monet's lily pads—an intriguingly dissonant image. There are several others just as appealing, and some of them are more explicitly science fiction or fantasy.

When asked which SF author was her favorite, Jane M. Lindskold pondered and chose Roger Zelazny because his "pieces had such a wide variety of moods and themes that his

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work never bored me." Having said that, she eventually wrote her one and only fan letter and began a long correspondence with Zelazny that culminated in **Roger Zelazny**, a book-length study of the man, the factors that have contributed to his work, and the work itself.

What emerges from this study is a portrait of an SF writer with very strong roots in classic English lit—Zelazny obtained a master's degree "with a concentration in the Elizabethan and Jacobean playwrights"—and the sort of broad knowledge base acquired only by an intellectual omnivore. In college and grad school, Zelazny audited numerous courses just because they seemed interesting; he still reads widely and variously, following a plan designed to acquaint him with as much of human knowledge as is possible in a single lifetime. He also studies martial arts, and all of these things help to make his writing what it is. So do the places around him (such as the Santa Fe area, where he lives), the music he listens to, and the artwork he encounters. His skills as a poet—a literary genre Zelazny rejected in the interests of making a living as a writer —show throughout his work.

But all this is only part of the portrait. Lindskold also shows us in Zelazny a man who hates the idea of limitations. This is in part why he studies so widely and voraciously. It also shows when Zelazny realizes—either on his own or when he is accused—that he is doing too much of the same thing. Too many male protagonists? Then his next story features a woman. Too many themes of one kind? Try something different.

Try something different. That sentence might well be taken as Zelazny's motto (just as "Ask the next question" was Ted Sturgeon's), and Lindskold successfully shows us how it works out in his writing. It also, of course, helps to explain why his work does not bore his fans.

Is it a weakness that Lindskold began as a fan and based much of her book on her correspondence and meetings with Zelazny? Her academic credentials are certainly in order, for she is an assistant professor of English at Lynchburg College in Virginia. As one would expect, she has read Zelazny's work and that of his critics and thought carefully about it all. But she quotes Zelazny's letters so extensively and her attitude is so unremittingly positive that I wound up thinking of her book as more of an apologia—a defensive puff piece —than an objective critical study.

From an academic standpoint, her bias in Zelazny's favor is a definite problem. For Zelazny fans, on the other hand, her bias is surely no problem at all. ■

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BRASS TACKS

Dear Dr. Schmidt:

Much as I like Jeffery D. Kooistra's writing, I'm afraid I must criticize his story, "Puff" (Mid-December 1993). His animals do not behave like animals I know.

My very first problem is with the narrator. He should not be narrating the story for the simple reason that he got killed on page 122. That's where he defends his cat and his daughter against a vicious dog. He indicates the dog is vicious because it is part pit bull. I might add that pit bulls are not automatically vicious, but because they are trained to be fighting dogs, they easily turn vicious.

The problem with pit bulls is that once attacked, their instincts are to attack non-stop until they win or die. The narrator slugs the dog and "It yelped and took off." Sorry, but that's the point at which it killed the narrator. There are stories by policemen of being mauled by pit bulls after having shot and clubbed the dogs. Running off yelping isn't in their genetic makeup. (This might be an idea for a bad sci-fi adventure story—facing an army of genetically programmed pit-bullmen?)

The author could have gotten around it by just having the dog be a vicious stray. But that brings up another question; the narrator goes hunting for the dog over the next few months and fails. Why didn't he call the Humane Society? There's a reason why they are called Animal Control Officers. They don't only check on animal abuse, they round up strays, particularly vicious strays if a complaint has been made that a dog went after a child. The author could have gotten around this by saying the Humane Society was also hunting the dogs but was also unable to catch them—this would make the achievement of Puff all the more impressive when he kills the dog after humans fail to.

It's Puff however that I really have problems with. One problem is having him toast marshmallows. That's cute, but there's a reason why animals are afraid of fire. Animals have fur. Fur catches on fire.

OK, Puff is a genius cat who knows to stay a safe distance away. If he's a safe distance away, he can't toast a marshmallow. The problem is the weight of the marshmallow and the leverage involved in holding the shish-kebab. I don't see how he could hold the marshmallow on the shish-kebab stick without being so close he would singe his little whiskers.

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And then he pats out the flaming marshmallow with his cute little paw. At which point the fur on his foot catches fire and he is badly burned. Even if he avoids that, he still gets a bad burn from the flaming marshmallow itself. I mean, would you pat out a flaming marshmallow with your bare hand? You would not because you know a marshmallow is sticky and that would give you a really nasty little burn. And, if you want to be really accurate, would you pat out a flaming marshmallow with your bare foot? That's what Puff does. For a genius, Puff is not very smart. Remember, he has to walk on that paw, so if he even scorches it slightly, he's lame for awhile. I don't see him making that mistake twice.

And finally, he goes off in the woods. End of story, paw prints of an adult cat and five or six kittens toasting marshmallows. And the marshmallow-toasting genius cats will take over the world.

Problem. Puff is a male. He is a tom cat. Toms do not get married and settle down with Mrs. Cat to raise the kiddies. A female cat in heat simply mates with every male she can. End of relationship. Furthermore, she can have more than one father for the same litter of kittens. Now that might be an interesting story, half of one litter are genetic geniuses and the other half are normal cats, but it's not the author's story.

Further, male cats have a bad habit of killing kittens. Therefore, no mother cat would ever allow the male near her kittens.

This problem would have been avoided by making Puff a female cat. Actually, an interesting problem is raised. With an ordinary cat as mother and the genius kittens staying kittens, would the mother cat keep mothering them? Or would she at some point say, "You've been around for two years. Grow up already!" In other words, is a cat's mothering instinct based on a time-limit or on the kittenness of her babies?

I'm sorry to be so critical because I like Jeffery Kooistra. I just suspect he should not write about animals!

MARIAN POWELL

Silver City, NM

The author replies. . . .

Dear Stan,

I am cheered that Marian Powell likes my writing, and although I typically don't respond to criticism, she suggested that I not write about animals anymore, and I can't just roll over and play dead. (And besides, she didn't mention any of the really big problems.)

Her first point is that the narrator should be dead after the encounter with the "part pit bull" stray because pit bulls, once attacked, instinctively fight until they win or die. I could argue over just how "hardwired" these instincts are in pit bulls, but it is moot since the narrator never encounters a pit bull, but rather a stray mutt showing "flashes of pit bull ancestry." I added the pit bull part for emotional effect, since pit bulls have been getting a bad press lately, but even assuming they are the instinctive terrors Ms. Powell states, such traits need not show up in later mutts

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a generation or two removed from the pure pit bull ancestor. My mutt was a vicious coward easily deterred by a bigger adversary (no doubt his ancestral waters were muddied with poodles).

She also notes that the narrator didn't contact the Humane Society. However, earlier in the story I mention that "we killed several (strays)" implying, at least to my mind, that the folks in this little enclave are used to dealing with the "stray problem" on their own. One may speculate about earlier dealings with a less than enthusiastic/competent set of Animal Control Officers, but I didn't see the need to bring it up.

The second criticism is about Puff and the marshmallows. Admittedly, my tongue was in my cheek, and I only had him burn the marshmallows first (I'm a patient roaster myself) because my wife likes them that way. But....

Assuming a standard one marshmallow mass at the end of a 30 cm wooden shish-kebab stick—well, the leverage is trivial. And 30 cm from a stove burner set at a reasonable flame is no hot spot. So I don't know why Ms. Powell has a problem with that aspect. As for the bad burn in patting out the marshmallow, I can tell that Ms. Powell hasn't actually tried it, as I have. Puff is a smart kitty, and he figured out by observation that marshmallows burn mainly on the surface at first, and that much of the flame is extinguished upon contact with the plate, and that the thin, burning shell that's left is easily and rapidly smothered under, not cute little paws, but toughened-from-playing out-in-the-yard paws. And the sticky residue is a delightful treat during after dinner paws lickings. As for burning fur, it's true that a lesser cat probably would toast himself. But not Puff.

And finally, Puff's maleness. There really isn't anything to refute here since there isn't a problem. The narrator saw paw prints, evidence of marshmallow roastings, and never heard dogs barking anymore. I leave it to the readers to invent whatever scenario they want to bring this about. Does Puff keep a harem? Does he kill the kittens that don't show his traits? Does he kill the mother after the kittens are weaned? I mean, a cat that can build the trap described can figure out how to keep any number of breeding females close at hand. And one other point: In one year, a single male cat can theoretically sire hundreds of kittens. A single female cannot.

JEFFERY D. KOOISTRA

Dear Mr. Schmidt,

First off, let me congratulate you on the short story "Puff." There are nearly legions of stories about how humanity might go about creating another intelligent life form on purpose, but those dealing with its creation via what I like to call "serendipitous screw-ups" are rare. "Puff" looks at the problem, and gives the reader a good story in the process.

The same can not be said, I fear, for that issue's science fact article, "Comes the Revolution." At one point, Mr. Stein [*sic*] asserts that the

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plan he draws up is one that could be taken to the financial community. Hardly. Mr. Stein's [*sic*] projected space line would have to raise some huge sums of money to get started. The cost of buying the SSTO vehicle alone would demand at least $10 billion (20 vehicles at $500 million each) in either cash or commitments to the vehicle maker. This would be in addition to the costs of spare parts ("The only part that doesn't break is the one that stays on the shelf" engineering adage), personnel hiring and training, office space rental and all of the other related costs of getting any business off the ground.

Motorola, which is getting together funding for its Iridium program, has set itself the task of raising between four and five billion dollars. To date, about two years after they started, they have commitments totaling only about one quarter of that amount. Would a start-up company, one without Motorola's long track record, stand any chance of assembling such a huge financial base in any reasonable amount of time? Then he sets the same company the task of flying 2,000 missions per year (20 vehicles flying 100 missions each), which is over *10 times* the number of flights now being conducted to *all* orbits. Mr. Stein observes that there will be a need for the market to grow, but then resorts to two dubious assumptions to brush the amount of growth needed aside. First, we are told, we'll use the vehicles to fly business people to various places in a hurry. The article quotes a price to orbit of roughly $14,000. A sub-orbital hop will subject the airframe and other systems of the SSTO to a large fraction of the strains an orbital mission would, so to recover fixed operating costs, the cost of such a suborbital flight would have to be a large fraction of the cost of an orbital flight. The exact fraction would depend on the distance of the flight, but even at only 50% of the cost, does it seem realistic that any company will spend $7,000 to fly someone somewhere, especially when the costs of telecommunications services like video conference links are dropping so rapidly? It also flies in the face of recent trends in corporate travel spending, that all point towards doing everything possible to lower these costs (a good examination of this can be found in the Nov. 28, 1993 "Business" section of the Chicago *Tribune*). The second false assertion is that the company can somehow make it by just "keeping them flying."

During the recent strike by American Airlines' flight attendants, the airline tried a similar tactic. The result was that they lost, by their own estimations, an average of $10 million a day flying aircraft without passengers. These are not losses that a company just starting up could afford, and American was hard pressed to cover them with its (relatively) deep cash reserves. Can the demand for actual orbital flights grow fast enough to still make a space transportation line a paying concern? Given current projections of launch demand, it would seem doubtful at best. Most industry projections are for a reduction in demand for launch services over the next decade, not for an increase.

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Would the projected effort benefit from a "If you build it, they will come" move, and, even if it could, is that the sort of attitude you'd want to go to the bankers with?

The figures used to justify these assertions also don't match up with what the people working in the field are saying. McDonnell-Douglas, the only company actively working on the idea of SSTO transportation has, on several occasions, given its estimations of what a mission would cost. That figure has remained fairly stable: Delta Clipper missions would cost approximately $10 million each. Given these figures, a ticket to orbit would now cost, using Mr. Stein figures on "break even," somewhere between $87,000 and $88,000 each. To buy that ticket now would take more like a second mortgage on the house than not buying a new car.

I have no doubt that Mr. Stein's article will be one of the more popular that you've carried in recent years, and that this letter will be one of the least popular. After all, Mr. Stein tells everyone what they want to hear. It isn't, however, a plan that we can go out and start a business with. Financial folks would ask the same questions, probably in less friendly terms, and more than likely come to the same conclusions this reader has: Mr. Stein has only proven that, given a spread sheet and the freedom to plug in any numbers you want, you can "prove" that any business proposition is possible.

ANDREW REYNOLDS

Rochelle, IL

* * *

The author replies....

Dear Stan:

Paul Hans and I did a thorough job on our economic model because we knew it would be loudly criticized. It doesn't agree with the prevailing thinking, the accepted paradigm. So, we consulted with people from such firms as Northwest Airlines, America West Airlines, Federal Express, and McDonnell Douglas Corporation. Paul Hans is the former chief financial officer of Arvin Industries, the director of corporate development for General Dynamics, the vice president for strategic planning for Sabreliner Corporation, and a merchant banker. We accounted for everything that Mr. Reynolds claims we did not.

As for the viability of the Earth-to-orbit market, it is very similar to America West Airlines establishing non-stop service between Phoenix and Des Moines. "The market won't support it," was the complaint from experts. America West: "If we establish the service, it will create the market." And it did.

McDonnell Douglas quoted costs: Dr. William A. Gaubatz, Delta Clipper program manager, is aware of our work and assisted in providing the numbers. MDC has remarked about a $10 million per flight price. This is different from "cost." If the cheapest service is now priced at about $70 million for a Delta, why not start out by charging $10 million for an SSTO flight when the actual cost is $1.4 million? Tidy profit that helps amortize the capital investment faster, what? Actually, if I were running the spaceline, I'd start out charging $10 million

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per flight until someone else came along and started charging $9 million. Then I'd drop the price to beat the competition, knowing that I had a big cushion to work with.

Motorola: I was at the Project Iridium kickoff luncheon given by Motorola in Phoenix on 16 September 1993. Motorola has put its partnership together and they have raised the capital required for the Iridium Project. End of controversy.

I didn't tell the readers and "space geeks" what they wanted to hear. I gored some sacred oxen in my article. I angered the techies by pointing out that the technology used would be irrelevant. I upset the "marketing experts," the same sorts of people who forecast in 1949 that there was no market for computers. This study conclusively showed that only 9 IBM Selective Sequence Electronic Calculators (SSEC) using 12,500 vacuum tubes, 21,400 electromechanical relays, punched paper tape for memory storage, and capable of adding or subtracting 19-digit numbers in less than 300 milliseconds would be adequate to handle all of the data processing and scientific computing tasks for the entire United States for the next four decades.

May I enquire concerning Mr. Reynolds's qualifications for making the statements he did?

And, no, Paul Hans and I will not reveal our economic model to the world for nothing. Information is valuable. We have time and effort invested in the work. It is proprietary to The Enterprise Institute, Inc. in Phoenix where we believe that anything worth doing is worth doing for money. If Mr. Reynolds or anyone else wants to know more, please ask them to write concerning our consulting rates.

With SSTO, we've overcome Objection Number One of Arthur C. Clarke's famous observation concerning the three phases of acceptance of a new paradigm: "It can't be done. Don't waste my time!" We are now in the period of overcoming Objection Number Two: "Well, maybe it can be done, but it isn't worth it."

In closing, Mr. Reynolds could not have read my article very carefully. He misspelled my name.

G. HARRY STINE

Dear Dr. Schmidt,

I like *Analog* because every so often it contains a story that really nails an issue. Like the story "Paper Virus" by Joe Martino in the Mid-December issue, which emphasizes a very important fact: Most scientists never thoroughly question the assumptions of their predecessors, or of science itself. Now, I also know there are good reasons why this is so in many cases, but as the story shows, there are cases in which those reasons are not good enough!

Something I find even more surprising, however, is the reluctance of science fiction writers to question such assumptions. It is really true that it only takes one contradiction to invalidate a logical system, and science is part of a larger system known as a culture. This is very important because the purpose of science is to provide us with objective knowledge

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of the Universe which we can use to help us survive and improve the quality of our lives. Science and its impressive achievements is what has made Western culture so successful. It probably sounds strange to think of a culture as logical, and certainly most are not, but one that values science must be logical—or long-term science cannot survive; this is true because science presupposes reason.

Most people interested in science rarely question the presuppositions of science in this regard. They accept as a given that science stands on its own, or at least its importance is so obvious that no one would ever seriously attack it. But how sure are you that that assumption (and others science depends on) is true? And how can such assumptions be validated?

More and more often we see science being attacked. Scientific objectivity is coming to be viewed as just "another opinion" that is equally valid with those of any other group, regardless of its method of arriving at that opinion. What the born-again Christians started with their creationism "science" has spread to many other areas; now the views of primitive tribal cultures are taken by many people as having equal standing with scientific theory: "They just have another perspective after all . . . I mean, everything is relative, right? There are no absolutes, right?" Or so say the advocates of the politically correct who are taking over our culture.

Most people do not realize how much of what they read and hear about environmentalism or AIDS, for example, is based on pseudo science. Politicians then use this false information to make important policy decisions that are very likely to have disastrous consequences because they are effectively arbitrary, being based on invalid assumptions.

Well, as Joe Martino pointed out in his story, if you allow a single contradiction into your logical system you invalidate it and virtually anything can be justified. Science does not exist in a vacuum; it presupposes method, structured content, and a processor; in other words, logic, valid concepts, a world of objects, and human consciousness to do the processing. And those things depend on a culture that values them. This wider context is ignored by scientists and science fiction writers alike; our culture is full of contradictions like: "There are no absolutes," or "Reality is relative to the beholder," or "Some facts are unknowable," and so on.

If science is to survive, contradictions must be eradicated from the foundations of science and the proper cultural basis of reason, science, and objectivity identified and validated. Scientists and others who ignore or accept such contradictions into our culture do so at our peril. Science depends on a rational culture, not one that embraces unreason. (Remember the Dark Ages?)

Readers who are interested in more information or in doing further study on bad science should read the work of Drs. Dixie Lee Ray and Jay H. Lehr. To learn more about how to validate the assumptions on which reason, good science, and objectivity depend, read the work of Dr. Leonard

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Peikoff.

You will not be disappointed. In fact, it's almost as interesting as reading science fiction!

GREGORY J. CZORA

Cupertino, CA

Dear Stan,

There's another point to make on the "college for all Americans" idea (Mid-December editorial). The educational bureaucracy likes to assume that "education" and "schooling" are the same thing, when they aren't. In this, they've been abetted in recent years by company hiring practices; paperwork is so much easier to judge than talent, or ability.

When I worked for a Honeywell factory in the early 1960s, two of the four or five project engineers, and the technical writer and illustrator (me), had never gone to college. That doesn't seem to happen anymore; one is hired and promoted according to one's credentials, rather than one's ability, or experience. Someone with a doctorate is assumed to know more than someone else with a B.A, who in turn is expected to know more than a high school graduate. I suppose this is mostly true—but not entirely. Of course, hiring by ability means that the individual who does the hiring has to be able to recognize ability when he or she sees it, while hiring by credentials is "safe." Which is why you're absolutely correct to say that giving everyone a college degree will devalue that degree. Promoting grade school students who received failing grades because it would damage their psyches or to get them out of the way of the next year's class is what devalued the high school education.

ROBERT COULSON ■

EDITOR'S NOTE: If you would like your address to appear with your Brass Tacks letter, then please write the address at the bottom *of the letter, after your signature.*

The science is as important as the fiction when it comes to sense of wonder, because what's being experienced is a glimpse of how awesome and marvellous reality might be.

E.R. Stewart

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AN SEPTEMBER '94

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UPCOMING EVENTS Anthony Lewis

19-21 August
CASCADE CON '94 (Portland area SF conference) at Shilo Inn Portland/Beaverton, Ore. Registration—$40 until 31 May; $45 thereafter and at the door. Info: Cascade Con, Box 86734. Portland OR 97286. (503) 777-0537.

26-28 August
DEEPSOUTHCON 32/B'HAMACON 3 (Deep South SF conference) at Radisson Hotel, Birmingham, Ala. Guest of Honor—Lois McMaster Bujold; TM—Mike Resnick; Fan Guest of Honor—Bob Shaw; Artist Guests of Honor—Debbie Hughes and Mark Maxwell. Registration—$25 until 1 August; $30 thereafter and at the door (payable to Debbie Rowan). Info: B'hamacon III Registration, % Debbie Rowan, Box 94151, Birmingham AL 45220-4151.

26-28 August
BUBONICON 26 (New Mexico SF conference) at Howard Johnson East, Albuquerque, N.M. Guest of Honor—Mike Stackpole; Artist Guest—Liz Danforth; TM—Simon Hawke. Registration—$21 until 10 August; $25 at the door. Info: NMSF Conference, Box 37257, Albuquerque NM 87176. (505) 266-8905.

1-5 September
CONADIAN (52nd World Science Fiction Convention) at Convention Centre, Winnipeg, Manitoba. Guest of Honour—Anne McCaffrey; Artist Guest of Honour—George Barr; Fan Guest of Honour—Robert Runté; TM—Barry Longyear. Registration—$125 (C$165) until 15 July; Supporting—$25 (C$30). At-door rates not set as of the time of this listing but will be greater than current attending rates. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info: Conadian, Box 2430, Winnipeg MB R3C 4A7 Canada (preferred) or Box 7111, Fargo ND 58109 (204) 942-9494; FAX (204) 944-1998.

Canvention 14 (Canadian National SF convention) will be held concurrently with the Worldcon. Info: Diane L. Walton (403) 924-3540.

16-18 September
MOSCON XVI (Idaho SF conference) at University Inn Best Western, Moscow, Idaho. Guest of Honor—Roger Zelazny; Artist Guest of Honor—Gary Davis; Fan Guests of Honor—Tam & Shelly Gordy. Info: MosCon XVI, Box 8521, Moscow ID 83843. ■

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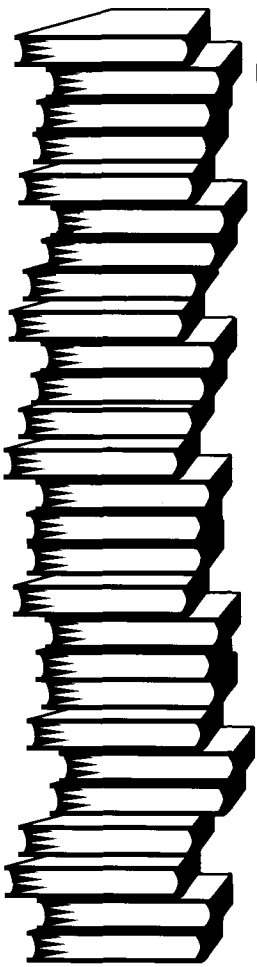

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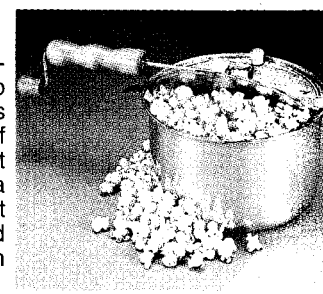

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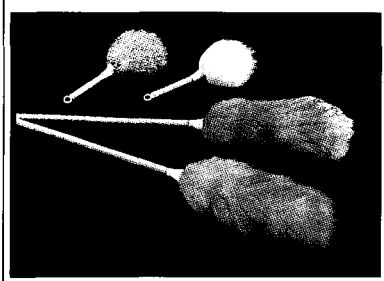

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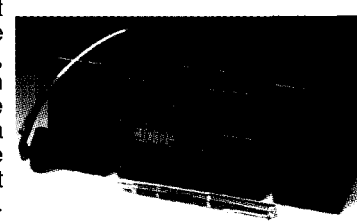

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